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ELECTRIC RAILWAY TRACTION

A Supplement illustrating and describing developments in Electric Railway Traction is presented with each copy of this week's issue.

The Smyrna to Aidin Railway

ON page 1073 we publish an article giving a short history of the Ottoman Railway from Smyrna to Aidin, which is to pass into the hands of the Turkish Government as from tomorrow if the agreement for its purchase is ratified by the company's stockholders. This railway is of particular interest as being the first to be constructed in Asiatic Turkey and the last in that territory to be taken over by the State. In the 14 years immediately preceding the entry of Turkey into the war the railway was a prosperous undertaking, paying regular dividends, but it was taken over by the Turks in November, 1914, and was not wholly restored to the company's management until November, 1922. Since 1913 no dividend has been paid on the ordinary shares, and only one (in 1929) on the preference capital. Its share and loan capital stands at £4,892,875, whereas the sum to be paid by the Turkish Government, if the purchase agreement is ratified, is only £1,825,840. A circular has been addressed by the directors to the stockholders advising them, in the circumstances, to approve a proposed scheme and to ratify the agreement. The alternative, in the view of the directors, is that the system would soon become worthless, due to the fact that the Government has begun to build a competing railway. The scheme proposes an equitable distribution of the purchase money, in which all classes of stockholders will participate, and will be submitted to meetings on June 7. If the scheme is approved, there is a hope of its being sanctioned before June 26, the date fixed for meetings to pass resolutions ratifying the agreement for sale, which resolutions are required by that agreement to be passed before July 1 under penalty of the agreement becoming void.

* * * *

Railways and Burgh Customs Dues

Customs duties on goods which were levied by two Scottish burghs under ancient charters and were by early railway legislation imposed on railway companies were mentioned by Mr. W. V. Wood, Vice President, L.M.S.R., in the course of his evidence before the Railway Rates Tribunal on May 22. By a charter of James VI in 1600, the magistrates of Perth were confirmed in their immemorial usage to levy customs on goods entering, leaving, or passing through the burgh. When, in 1845, the Scottish Central and other railway Bills were before Parliament, the magistrates petitioned and obtained protective clauses, under which the companies now forming the L.M.S.R. became liable for annual payments in perpetuity of £385. It is only this year that the company has been able to redeem the payment for a lump sum of £6,738. Stirling had a charter of Robert II in 1386 confirming an immemorial usage there of payments by means of salt and skins, which were subsequently converted into cash. The Stirling magistrates petitioned Parliament for the loss of dues collected by them owing to the diversion of traffic from road to rail, and the compensation was fixed at £600 per annum for all time. That has now been redeemed for £10,800.

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The Week's Traffics

Traffics of the four group companies for the past week compare with a week in 1934 which included the Whitsuntide Bank Holiday receipts, so that passenger train earnings are down in every case, but goods and coal are up. Total receipts for the past week show increases in each instance but the Southern. For the year to date passenger train earnings show increases of £69,000 on the L.N.E.R., £66,000 on the Southern, and £36,000 on the L.M.S.R., but a decrease of £26,000 on the Great Western. In merchandise receipts increases of £62,000 and £30,000 respectively are recorded by the L.M.S.R. and the Great Western, but decreases of £106,000 are shown by the L.N.E.R. and of £82,500 by the Southern. Coal traffics are down in every instance, the aggregate decrease in this respect being £228,500 for the four companies.

	21st Week				Year to date.	
	Pass., &c.	Goods, &c.	Coal, &c.	Total.	Inc. or dec.	
	£	£	£	£	£	%
L.M.S.R. ..	− 57,000	+ 103,000	+ 74,000	+ 120,000	+ 72,000	+ 0·31
L.N.E.R. ..	− 46,000	+ 39,000	+ 69,000	+ 62,000	− 172,000	− 1·006
G.W.R. ..	− 21,000	+ 43,000	+ 37,000	+ 59,000	− 22,000	− 0·23
S.R. ..	− 35,000	+ 2,500	+ 7,500	− 25,000	− 58,000	− 0·79

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Western Australia and Secession

The Joint Committee of the Houses of Lords and Commons appointed to consider the petition of Western Australia for the introduction and passage of a Bill in the British Parliament to enable Western Australia to withdraw from the Commonwealth of Australia has reported that the petition is not proper to be received. This conclusion is reached on constitutional grounds alone, the committee having expressly refrained from entering into the merits of the case, into the accuracy of the facts recited in the petition, or into the question whether the complaint

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of grievances set out in the petition is justified. The case for secession was discussed in an editorial article in THE RAILWAY GAZETTE of February 1, 1935. In the opinion of the committee the British Parliament has legally the power to pass such an Act as Western Australia desired, but to do so without the express request of the Commonwealth Parliament would be contrary to the well established constitutional practice governing the relations between this country and the self-governing Dominions, which practice has been confirmed by the Statute of Westminster. The remedy for the admittedly hard case of Western Australia must now be sought in Australia itself. General Sir Newton Moore, in a recent letter to *The Times*, has well described Western Australia's position. It is almost entirely a primary producing State and its products are sold at world prices, while it is compelled to purchase the bulk of its requirements from the highly protected industries in the eastern States. These purchases amount to approximately £10,000,000 a year, as against exports of under £1,000,000 from Western Australia to eastern Australia.

* * * *

Seeing More of Britain

The London & North Eastern Railway has produced a booklet of travel information which strikes us as having possibilities in a wider sphere than that for which it is primarily designed. Entitled "Educational Tours in Eastern Britain," it is addressed in particular to the scholastic profession, to which it points out the benefit of arranging visits for students to places which might otherwise remain mere classroom names. The chapters deal with famous cathedral cities, the Roman Wall, Cambridge, London, and Edinburgh, most of them described by a recognised authority, and all illustrated with attractive black and white sketches. It is to be hoped that this book will come into the hands of others besides those connected with education, for it is calculated to revive the desire to visit places off the more frequented holiday routes, which most have felt, but many forget, under the illusion that circumstances limit them to one long journey a year, and that to a popular resort. The knowledge that aspirations to see the historic cities, or even the large industrial towns, of this country are recognised as legitimate motives for travel should result in the possibilities of express half-day excursions being still more widely investigated.

* * * *

Railways and Wagon User

When raising certain questions in last week's issue as to wagon user, Mr. M. F. Barnard, the Assistant Secretary of the British Iron and Steel Federation, apparently overlooked two important points mentioned in the editorial to which he referred. The comments made therein related particularly to seasonal traffics, and the importation of iron and steel goods is certainly not seasonal to the extent to which, for example, timber traffic is. Further, the loss of user to which we referred arises in connection with wagons which, through lack of accommodation at destination, have to be held under load at points intermediate between the forwarding and receiving stations in circumstances in which demurrage has hitherto not been charged. Thus, any comparative data as to the time wagons are held in private sidings or stations, or the amount of revenue earned from demurrage charges in 1913 and 1935 respectively, would not have any material bearing on the question; and, moreover, the widespread alterations which have occurred during this period in the tonnage, nature and general flow of traffic would entirely vitiate any such comparison.

Wireless Publicity for Railways

Whatever the drawbacks of wireless advertising may be, it has the great advantage of penetrating into the home, and, supposing it to be tactfully handled, of appealing to a public in a receptive mood. For this reason it is perhaps regarded enviously by some railway publicity officers, who recognise that posters on station sites and lineside hoardings are mainly seen by people in a hurry. An interesting experiment in the use of the spoken word as a medium for conveying impressions of scenery has been undertaken by the New Zealand Government Railways, whose Publicity Manager, Mr. George G. Stewart, has broadcast a series of talks from the wireless station at Wellington. One of these, dealing with the South Island, was published in a recent issue of *The New Zealand Railways Magazine*, and was remarkable both for the success of its scenic descriptions and the breadth of its scope. Mr. Stewart assumed that his listeners were as interested as himself in their own country, so that his talk was planned to be rich in allusions to local history and enterprise. Its merits as publicity were allowed to depend upon its value as entertainment, and it may be judged that the whole series has been equally successful in both directions.

* * * *

Delicate Attentions

It was cheering to read the recent announcement of the London & North Eastern Railway that in future the patrons of its hotels will pay no supplementary charge for the enjoyment of baths. But the solicitude of the L.N.E.R. for its visitors is not now confined to mere externals. On the sound ethical principle that, while "the outside of the cup and platter" may be unexceptionally clean, the inside may yet be "full of ravening wickedness," L.N.E.R. hotels now provide, in the bedrooms, small and attractive tins of a well-known liver salt, with the felicitous inscription, "Here's health. With best wishes from the L.N.E.R." This doubtless has its reflex value to the hotel staffs. Tables of "Merry Andrews" at breakfast must be much easier to handle than groups of breakfasters afflicted with customary matutinal moroseness; furthermore, disputes as to the reasonableness of charges are likely in these circumstances to be reduced to the veriest minimum. A certain amount of self-interest therefore attaches to this L.N.E.R. gift. Until recently, the particular bodily care of the London Midland & Scottish Railway for its hotel patrons expressed itself in the gift of a certain brand of dentifrice, to which, in consequence, we transferred our patronage. Unfortunately this interest in dental welfare on the part of the L.M.S., has now come to an end. But with a thrift not far removed from Scottish, we have accumulated a sufficient store of these tubes to preserve our own molars from decay, we trust, for some considerable time to come.

* * * *

Feet on the Seat

It is a strange sidelight on the vandalism of the modern world that the London Passenger Transport Board has found it necessary to display in certain trains a notice reading "please keep your feet off the seat." We ourselves have always felt that a seat on the Underground is an object sufficiently rare to be entitled to a degree of veneration, and were one to be vouchsafed us we imagine that our feet are the least likely part of our person that we should choose to accommodate thereon. Our delicacy of feeling in this respect, however, does not blind us to the fact that there may be growing up a generation of

travellers unaware of the uses of the common cushion. For their benefit we hasten to point out that one of these is not to serve as a mat, however well adapted for the purpose it may appear. To the purely analytical mind, no doubt, a knife recommends itself as a convenient instrument for the consumption of peas, yet society has agreed to proscribe any person found giving the theory practical expression. In this case, however, the *faux pas* borrows dignity from the personal risk incurred by the inexpert practitioner, whereas the barbarism of the trampler upon seats is unredeemed, since it menaces none but his fellows.

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Speeding-Up in Denmark

Convincing justification for the building by Denmark of the Little Belt bridge is furnished by the improvement of train service which it has brought about. Coupled with the introduction of three-car diesel-driven *Lyntog*, or high-speed trains, journey times between Copenhagen and various important towns in Jutland have been reduced by 35 per cent. and more. Between Copenhagen and Aarhus, for example, the best previous time of 7 hr. 17 min. with steam, and two train-ferry crossings to be made, has come down to 4 hr. 36 min. By the use of one of these units, again, it has been found possible, by starting the boat train from London (Liverpool Street) at 4.10 instead of 7.42 p.m., to bring the passenger into Copenhagen at 11.55 p.m. the next evening, instead of 7.40 a.m. the second morning, and of this overall gain of 4¼ hr., the railcar and the bridge between them are responsible for over 2¾ hr. The first mile-a-minute schedule on record in Denmark appears in the timetables, one of the railcars being booked to cover the 38·3 miles from Roskilde to Slagelse in 38 min., at 60·4 m.p.h. from start-to-stop; and many other timings are practically at the same level of speed, such as 124 min. for the 123·1 miles from Aarhus to Nyborg, and 126 min. in the opposite direction, which also, incidentally, are the first non-stop runs of over 100 miles in length to come into existence in Denmark. By the use of the bridge, also, considerable improvements have been effected in the through services between Copenhagen and Jutland and beyond, including the reinstatement of the through Paris-Copenhagen sleeping car.

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Marseilles-Toulon Excursions on the P.L.M.

To compete with road transport between Marseilles and Toulon, the P.L.M. has for some two years been running a series of trains by which a specially low fare is charged, intermediately, or for the throughout journey. From Marseilles to Toulon (41¾ miles) the normal rate (single journey) is fr. 30·75, 20·75, and 13·75 in the three classes; return tickets, available two days, are fr. 45·75, 33, and 21·75. The special fares, which, however, offer no reduction for the return journey, are fr. 15·50, 10·50, and 6·75. The trains concerned, which are " starred " in the timetable, are mostly semi-fast, and the best of them have the distinction of being a little quicker than the ordinary service, being booked from Marseilles to Toulon in 58 min. with a stop at Bandol (one of them is allowed only 61 min. with three stops) as compared with the best non-stop timing of 55 min. by the Cote d'Azur Pullman. From Toulon to Marseilles the time is 59 min. (also with a Bandol stop) as compared with the best non-stop ordinary schedule of 56 min. The booking is faster than it looks, for the first 2½ miles out of Marseilles generally require at least 8 min., owing to the 20 km. (12½ m.) p.h. speed restrictions at the start, and at Marseille-Blancarde, but the trains are generally composed of six or seven vehicles only (157 or 187 tons) and are worked by 4-6-0 " B " class engines.

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An Expert on Railway Springing

The paper read before the Institution of Locomotive Engineers by Mr. T. H. Sanders and entitled " The Evolution of Railway Vehicles Suspension " was largely historical and for that reason was perhaps of even greater interest than if it had dealt solely with matters associated with modern railway vehicle springing practice. The author pointed out that in locomotive design the equalisation or compensation of the suspension springs is a matter of considerable importance. The three-point arrangement is the only one which is absolutely stable under all conditions, and practice in the United States adheres to this as an article of faith. A very usual modern type of express engine was the 4-6-2, and at least five different methods exist of arranging the suspension for this class. In England, with its high-class permanent way, some of the Pacific engines travel on nine suspension points, whereas in France with track almost as good, they travel on four points. The German railways also have a four-point arrangement but different from the French and somewhat less liable to roll, whilst the Belgian railways have a five-point compromise of the two foregoing. The American Pacifics have, of course, three points, and the engine rolls easily, which is rather necessary in view of the staggered joint permanent way which is the usual practice in that country. Reference was made by the author to Gooch's broad gauge tank engines of the " Corsair " type, which had inverted equaliser springs on the bogie with a beam compensating gear for the coupled wheels. The bogie movement was, however, sadly limited by the position of the large inverted springs, and the Great Western Railway later eliminated the bogie and provided fixed axles, at the same time retaining the spring arrangement.

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Dr. Wagner on Locomotive Problems

In replying to the numerous questions put to him in the discussion which followed his paper on " High Speed and the Steam Locomotive " at the Institution of Locomotive Engineers, Dr. Wagner added some valuable further information to his already interesting contribution. Asked about the use of brakes on the bogie wheels of locomotives, he said that the German railways had experienced a lot of trouble with bogie trucks in the last fifteen years, but latterly they had been able to overcome this by fixing all the brake arrangements on sprung parts and not on parts resting directly on the journals, as is usually done in the circumstances. As to the weight of the main frames riding on the bogie truck, Dr. Wagner said that in Germany they put the weight on both sides of the bogie for the last fifty years and that he was happy to say oscillation of the kind referred to by one of his questioners had never been noticed for the reason that pressure of the main frame was distributed on both sides of the truck, which represented the most effective damping possible to obtain. It was never found that the driver tended to over-grease these parts and so, in effect, the damping was even better than was intended by the designer. He went on to say that it was not customary on German locomotives to send the wheel load through the leading bogie truck frame, the arrangement being such that none of the forces went through the frame of the truck unless a spring broke—a special provision was made to meet the circumstance should this occur. The smallest curve the high speed locomotive could take was a radius of about 180 m., or 590 ft.

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Annual Review of Standard Charges

LAST week the Railway Rates Tribunal held its seventh annual review of the railway standard and exceptional charges, and, during the hearing, some very interesting evidence was given in regard to railway working during 1934. Figures submitted showed that, compared with 1929, the last "normal year" for railway traffics, the gross receipts of the four group companies during 1934 declined by £31,221,404, or 17·2 per cent., but the companies had been able to reduce their working expenses by no less than £19,597,595, or 13·75 per cent., a striking achievement seeing that so large a proportion of railway expenditure is unaffected by variations in traffic. Mr. W. V. Wood, a Vice-President of the L.M.S.R., in giving evidence on behalf of the four groups, claimed that, having regard to all the circumstances, these figures indicated that the railway undertakings were worked with economy during 1934, and then proceeded to give examples of the many directions in which economies had been allied with greater efficiency. The pooling arrangements between the L.M.S.R. and L.N.E.R., for instance, had considerably facilitated the working of traffic, and, at the same time, the fructification of the schemes already in operation was estimated ultimately to represent an annual saving of about £340,000, of which nearly £280,000 was already being secured. During the year passenger train services generally were accelerated, superior accommodation provided and the general amenities of travel greatly improved. On the freight train side, also, services had been speeded up and a more intensive user of rolling stock obtained. The use of containers for the conveyance of a variety of traffics had proved very popular with traders, and the companies' stock had risen from 3,400 in 1929 to 10,415 in 1934. These rapidly increasing numbers had proved of great assistance in enabling the companies to afford door-to-door conveyance.

Principally for the purpose of developing traffic, the railway companies adopted no fewer than 88,000 exceptional rates during the year as compared with 125,000 in the previous year, the reduction being due partly to the exercise of the companies' powers to charge "agreed charges." These powers had already been of valuable assistance to them in retaining and regaining traffic, although as yet the receipts from traffic so charged only represented about 1·66 per cent. of the total revenue from goods train and passenger train merchandise traffics. As indicative of increased locomotive efficiency, statistics were given showing that the average number of engine miles run per engine increased from 22,363 in 1923 to 23,636 in 1929 and then, in spite of considerably decreased traffics, to 23,765 in 1933 and 25,219 in 1934. Various types of diesel engine were also tried experimentally in various parts of the country, but Mr. Wood expressed the view that there was no indication that they would replace steam power generally. The year had been marked by a considerable development in the companies' road transport activities and the exercise of their powers in this connection was financially successful seeing that the net revenue earned amounted to £845,000. In addition the companies had found it possible to replace a number of branch line passenger train services by road motor services and had thereby effected an annual saving of £250,000. Collection and delivery services were extended and certain other advantages secured by the further co-ordination of rail and road services, the ability to afford comprehensive rail and road facilities and to convey certain short distance traffic economically by road throughout.

So far as ancillary businesses were concerned, the steady growth of dining car user was revealed by the statement that over 8 million meals were served during 1934, an increase of half a million over 1933. With regard to their canal undertakings, the loss sustained in working proved to be the lowest for many years, while a feature of note in connection with railway dock properties was that the expenditure at the G.W.R. docks at Cardiff, Newport, and Penarth exceeded the receipts by £35,000. Mr. Wood then made some interesting comparisons between passenger traffic in Great Britain and the United States, showing that whereas in Great Britain the passenger train traffic of the four group companies was 44 per cent. of the total receipts in 1923 and 45 per cent. in 1933, in the United States the corresponding figures were 24 per cent. in 1923 and 16 per cent. in 1933. Taking passenger receipts only, he estimated that in ten years there had been a decline in Great Britain of 28 per cent. and in America of 71 per cent., indicating that the passenger traffic in the United States had shown much less resistance to road competition. Further, the four main line railway companies were now running 18,000 million passenger miles as compared with 16,000 million run by the United States lines. After hearing further evidence the tribunal reserved its decision and will give its judgment at a later date.

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German State Railway, 1934

WHEN reviewing last year the annual report of the German State Railway, we remarked that its general tone was one of qualified optimism. That such optimism was justified is shown by the report for 1934, which has just been issued. The rise in traffic and receipts in the second half of 1933 has continued and once more enables a favourable balance on operating account to be recorded, the operating ratio being 99·28, against 104·66 in 1933 and 102·27 in 1932. The balance, it is true, is small, but there is every indication that the improvement will continue, and it is confidently expected that still better results will be recorded for the current year. A loss on working of 135,997,573 RM. for 1933 has been turned into a surplus of 24,046,602 RM., representing a considerable step forward. As in the previous year, receipts have not kept pace with the growth of traffic, due to the wide use made of cheap fare facilities, 64 per cent. of all passengers travelling at less than standard fares, against 60·9 in 1933. In goods traffic similar conditions obtained, 65·8 per cent. of it being conveyed at reduced rates. Some was even conveyed free in connection with national work schemes. It is therefore not surprising that the profit on working is no larger than it is. The number of passengers carried rose 9·6 per cent. and the goods tonnage 18·7 per cent. Receipts increased 8·4 and 17·9 per cent. respectively and the gross receipts 13·9 per cent. The figures for the last three years are:—

	1934	1933	1932
Passengers carried, millions ..	1,359·6	1,240·5	1,305·1
Goods tonnage, million tonnes* ..	316·4	262·7	242·0
Passenger and luggage receipts, million RM.	917·0	845·9	900·7
Goods receipts, million RM. ..	2,140·0	1,815·2	1,729·1
Gross receipts, million RM. ..	3,326·3	2,920·6	2,934·3
Expenses (operation, maintenance and renewals) million RM. ..	3,302·3	3,056·6	3,001·1
Balance on operating account, million RM.	+ 24·0	— 136·0	— 66·8
Operating ratio, per cent. ..	99·28	104·66	102·27

* Excluding service material.

The operating surplus of 24,061,602 RM. represents very little of the total credit side of the profit and loss account, which also includes 1,983,043 RM. brought forward from 1933, and 33,443,273 RM. exceptional receipts, made up of 17,121,370 RM. from passenger tax vouchers, 8,776,458 RM.

sums received in connection with the work undertaken under the unemployment laws and decrees, and 7,545,445 RM. from the Reich credit, 5½ per cent. loan. In addition there are two sums, one of 40,452,646 RM. from the statutory dividend reserve and another of 86,500,000 RM. from the statutory equalisation reserve. On the credit side there are 70,000,000 RM. payment to the Reich, 26,384,173 RM. for debt and loan charges, 14,190,000 RM. for depreciation of additions and betterments, and 75,851,390 RM. for preference dividends. This leaves 181,390 RM. to carry forward. The passenger tax, amounting to 204,616,666 RM., is, of course, not reckoned in the operating account. The Reichsbahn contribution to the capital of the Reichsautobahnen is represented again by 50,000,000 RM. Stores show a great increase in value, from 34·7 million to 154·9 million RM., while the numerous works and improvements are represented by an additional 235,577,063 RM., bringing the asset value of the fixed undertaking to a total of 26,672,366,407 RM. The total debt stands at 2,853,500,000 RM., which is within satisfactory limits. The enormous importance of the undertaking in the general financial life of the country is shown by the size of the sums paid by, or through, it to the national finances or in connection with work having considerable national importance. Thus, 484,600,000 RM. are paid over in direct payments to the State as dividends on its preference holdings, passenger tax, pension charges, and charges occasioned by the frontier changes after the war necessitating compensation to numbers of individuals. The improved position is reflected in the increased employment that has resulted. Some 37,000 more persons were in the railway service on the average in 1934, compared with 1933, and at the end of the year there were 356,581 workmen and 274,324 staff. About 3,000 workmen and staff have been allocated to work in connection with the Reichsautobahnen. New methods of payment and promotion have been introduced, considered to be in accord with the social spirit represented by the present national policy and to give practical effect to the notion of the inherent dignity of labour.

In engineering activities of all kinds there has been noteworthy progress. Tunnels have been eliminated, bridges renewed and strengthened, many new stations built and better permanent way laid down over considerable distances. Electric traction has been extended to another 177 km. of route. Progress has been made with the north-south connecting line in Berlin. Several power signalling installations have been laid down, the ordinary mechanical signalling has been improved, particularly in regard to distant signal working, while long sections of main line have been fitted with an up-to-date automatic train control system, placing the Reichsbahn in an advanced position in this important matter. The rolling stock park is reported as having been sufficient, with good management, to cope with the traffic on the special occasions, such as political demonstrations, when very heavy traffic was concentrated towards one place. It was, however, the object of special attention in 1934, and locomotives and railcars of special design for high speed work constructed. The reducing of journey times, especially for the longer runs, received much attention also. The altered signalling has allowed of a speed of 120 km.p.h. on most main line sections, while 160 km.p.h. is allowable with railcars provided with automatic train control. The number of kilometres covered by trains having speeds of 100 km.p.h. and more rose by 67 per cent., and the slower speed trains were very much improved. On the light railways also speeds were considerably raised, making them much more effective and useful. An increase of 400 per cent. in the excursion train kilometres reflects the amount of traffic kilometres due to party congresses and other gatherings, including special trains conveying persons to and from the voluntary labour corps camps and depots. Goods services were greatly accelerated also. A number of trains having a speed of 75 km.p.h. were instituted, and it is intended to improve the working generally up to this level. Shunting time at stations was cut down by the introduction of diesel tractors, so that the train engine was not required for the work. The use of containers was extended. The accident record was unfortunately not so good as in 1933, but it was still creditable, when everything is considered. The magnitude of an accident has often little connection with its causes, and statistics on the subject need cautious interpretation. The report bears evidence throughout of the continuance of scientific work combined with enterprise which makes the Reichsbahn one of the foremost railway undertakings of the world.

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Speed Competition in America

IT is quite clear that in America the steam locomotive is not to take "lying down" the competition of high speed diesel-driven railcars. On page 1409 reference is made to the effect on competing railways of the introduction by the Chicago, Burlington & Quincy RR. of high speed three-car units of the Zephyr type, foreshadowing the use of similar units between Chicago and the Twin Cities of St. Paul and Minneapolis. But some months before the new equipment was ready, the Chicago & North Western anticipated events by inaugurating a new express service called The 400 between the same cities, covering the 408·6 miles between Chicago and St. Paul in 7 hr. So successful was the service, and so punctual in operation, despite the snow and below-zero temperatures of January, February, and March, that in the first three months 28,000 passengers were carried, and the original four-car formation had to be expanded to six cars. Now the Chicago, Milwaukee, St. Paul & Pacific RR. has entered the field with The Hiawatha—a streamlined train with new locomotives of special design (described on page 1037 of last week's issue), and new lightweight coaches of welded construction, booked over the 410 miles of the C.M.St.P. & P. route between Chicago and St. Paul in 6½ hr. The result, of course, has been to bring down the time of The 400 of the C. & N.W. to 6½ hr., demanding an overall average speed, including stops, of well over 60 m.p.h. by both routes. The Burlington's Zephyr units have also been at work for the past month, covering the 431 miles of the Burlington route also in 6½ hr. between Chicago and St. Paul, an average of 66·3 m.p.h., four stops included. From June 2 each is to make the double journey daily.

Wisely, the three companies have arranged to start their high speed trains in both directions at different hours, ranging from 8 a.m. to 4 p.m., so that a range of facilities is thus provided. But the chief interest of this lively competition lies in the different methods that are being used to provide the speed. Beyond certain modifications to the Pacific locomotives used, such as the provision of larger driving wheels, Nicholson thermic syphons in the firebox, a slightly higher pressure, and detail refinements at the front end, as well as the use of oil-firing and tenders of larger capacity, the Chicago & North Western is running its speed trains with ordinary locomotives and stock. The Chicago, Milwaukee, St. Paul & Pacific, however, has, as already mentioned, built streamlined, oil-fired 4-4-2 locomotives, incorporating various features new to locomotive practice, and working at 300 lb. pressure, and trains of special streamlined stock which is only two-thirds the weight of the coaches usually employed. On

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the Chicago, Burlington & Quincy, reliance is placed, on the other hand, on diesel propulsion, incorporated in new articulated train sets of exceptionally light weight. Comparison of constructional and maintenance costs of these three different methods, in practically identical conditions of running, should prove extremely instructive, if the railways concerned see fit to make them public. It is not without interest, also, that further competition is provided between Chicago and Milwaukee in the shape of the Chicago, North Shore & Milwaukee RR., whose interurban service, fully described in our *Electric Railway Traction Supplement* of January 11, 1935, is unique in the exceptionally high speeds of its trains between stops; and in this case the motive power is electricity.

In other directions in America similar competition is rapidly developing. The original Burlington Zephyr unit, now installed in service between Lincoln, Omaha, and Kansas City, has stirred the Missouri Pacific RR. to reply with accelerations by 86 and 66 min. respectively of two existing steam services, now appropriately christened The Marathon, which have brought their journeys down to times almost exactly equalling those of the Zephyr. Between New York, Philadelphia, Baltimore, and Washington the electrification of the Pennsylvania main line, which for the first time in history has permitted the scheduling of a daily run between New York and Washington in less than 4 hr.—the Congressional Limited is allowed 235 min. for the 224·8 miles, four stops included—has aroused the Baltimore & Ohio management, and whereas the best B. & O. time, with steam traction, was 4 hr. 40 min. less than two years ago, it has now come down to 4 hr., in which 223·6 miles, including stops, are covered. The time-honoured competition between the New York Central Lines and the Pennsylvania Railroad, even though conducted with a certain measure of agreement between the two companies, has produced services without any parallel in the world for speed and frequency over so great a distance as that separating New York from Chicago. Three years ago two trains only—The Twentieth Century Limited and the Broadway Limited—both commanding a heavy supplementary fare, travelled between New York and Chicago in as little as 20 hr. To-day their times have been reduced to 17 hr.; nineteen expresses make the journey in less than 20 hr.; and the average time for thirty trains, fifteen over each route, works out at 19¼ hr. overall, giving an inclusive average of 50 m.p.h. for the 958·7 miles of the New York Central route, and 46·8 m.p.h. for the 901·7 miles of the Pennsylvania route. Among other accelerations, the Pennsylvania RR. has speeded up The Union—a train running between Cincinnati and Chicago—to a run of 54 min. over the 64·2 miles from Fort Wayne to Plymouth, giving a start-to-stop speed of 71·3 m.p.h. This, the fastest steam-hauled run in America, thus practically ties with the Cheltenham Flyer in Great Britain. But the Chicago, Burlington & Quincy RR. now claims the record for the U.S.A., as one of the two Zephyr diesel-driven trains working between Chicago and the Twin Cities has an intermediate booking timed at 73·3 m.p.h. Competition in the United States is thus proving extremely stimulating, and the American passenger stands proportionately to gain.

LETTERS TO THE EDITOR

(*The Editor is not responsible for the opinions of correspondents*)

Attractive Travel in France

56, St. Mary's Mansions, W.2.
May 22, 1935

To the Editor of The Railway Gazette

Sir,—I have been much struck on a recent visit to France with the neatness and cleanliness of the stations on the Etat. The excellent condition even of old buildings like Niort, or places in the throes of reconstruction like Le Mans, is really amazing, and it reminds me forcibly of Sir Cecil Paget's early "spring cleaning" days on the old Midland. It is a pleasure to travel on the Etat; the staff are neat and obliging, the punctuality is almost perfect, and the stock (on local as well as fast trains) is wonderfully clean and well-kept.

Yours faithfully,
R. E. CHARLEWOOD

Speed

Coll-Earn, Auchterarder, Perthshire, May 26

To the Editor of The Railway Gazette

Sir,—Mr. W. B. Thompson says Queen Victoria was interested in the possibilities of railways from a speed point of view. I think I may lift a corner of the veil that shrouds the Throne to set forth facts which I know personally.

Great interest prevailed at Balmoral in the matter of the London-Aberdeen Railway Race of 1895. So much so that various groups of the Royal Family who were going up to Balmoral to stay with their august relative not only forsook their usual route for another (which they thought was likely to speed the best) but also insisted on their special saloons being run on the "racer" and not on the time-tabled train which followed it.

I have never yet met that rare museum piece the man or the woman who will avoid a fast train for a slow one. Not that trains are wearisome to most folks, but common human nature loves a good thing and not a half-hearted one. And to the majority time is money or a quick arrival at the holiday spot is hotly hoped for. Moreover, speed develops that long distance traffic which is the most paying sort. It is better to take 44 shillings off your passenger rather than 4 shillings or 4 pence.

Those rare mocking-birds dwelling in the Olympian heights of their offices who decry speed might think out this: Would the long-distance omnibus ever have rode triumphant o'er the road had the railways, 10 or more years ago, used their real, main weapon of space destroying and time saving speed and at the same time reduced their fares to pre-war levels?

At Sunday post speed,
NORMAN DORAN MACDONALD

London Passenger Transport Pooling Scheme

Following the suggestion of Mr. Joshua Scholefield, K.C., President of London Passenger Transport Arbitration Tribunal, a modification to the scheme has now been submitted and on Tuesday received informal approval. Mr. Scholefield intimated that he hoped to seal the scheme later this week. The revised percentages of the pool, with the earlier figures in parentheses, are:—

L.P.T.B.	62·00473	(62·87900)
G.W.R.	1·33541	(1·11332)
L.M.S.R.	5·09340	(4·74747)
L.N.E.R.	6·01488	(5·80557)
S.R.	25·55158	(25·45464)

The revised figures include the division of poolable receipts from joint lines (after non-area traffic of the main line railways who are partners has been deducted). The earlier figures included for each party the whole of the joint line receipts for which it was to act as sponsor and in respect of which it was not final owner.

PUBLICATIONS RECEIVED

The **Military Engineer in India.** By Lieut.-Col. E. W. C. Sandes. Chatham: The Secretary, The Institution of Royal Engineers. 9¾ in. × 6½ in. × 1¼ in. 392 pp. Illustrated. With folding maps. Price 15s. net., post free.—Three chapters of this volume are concerned exclusively with Indian railways and their Royal Engineer officers. Of these, Chapter VII deals mainly with the history and development of the railways, and is of very considerable general interest. Chapter VIII, on the other hand, is confined rather more to the personal influence of individual officers of the corps on the railways, and Chapter IX to the Frontier lines. But in these chapters also there is a wealth of valuable detail upon such subjects as the construction of the Mushkaf-Bolan and Sind-Pishin lines to Quetta and the Khyber (spelt Khaibar in the work) Railway, all exceedingly heavy works. Those interested in railway history should certainly read these chapters, which are also excellently illustrated. Such vital points in Indian railway history as Lord Dalhousie's masterly Minute of April, 1853, are clearly brought out and few of the epics in the pioneering and later developments of the great 43,000-mile system of railways in the Indian Empire are omitted. Even for the civilian, therefore, these chapters are not only eminently readable, but far from uninteresting, and to those who know India they are absorbing. It is well to remember that India is still the principal railway training ground for R.E. officers, who are distributed over the State systems in the engineering and traffic departments, transportation branches or managements.

Railway Enterprise, L.M.S.R.: Origin and Subsequent Development of the Railways in Scotland. By John W. F. Gardner. Glasgow: Menzies & Co. 9½ in. × 6½ in. 76 pp. Illustrated. Price 3s. 6d. net.—On railway grouping at the beginning of 1923 the L.M.S.R. assumed control of some 2,124 route miles of railway north of the border. This mileage was taken over from three operating companies, namely, the Caledonian, Glasgow and South Western, and Highland Railways, but it had been built up during the preceding century by the process familiar in England of amalgamations among small local undertakings. This process has provided the author with his subject matter, and he sets out the facts of his story in an accurate and interesting manner. As the Caledonian and the G. & S.W.R. lines had much in common, they are considered together and in relation to the industrial expansion in the south of Scotland, which brought them into being. The Highland Railway was an entirely different matter, and, although commercial optimism could carry the railway up to Inverness, it was only the gift of long stretches of land and the money and enthusiasm of the then Duke of Sutherland which enabled the "farthest north" to be reached. Mr. Gardner has told his story well, and if we regret his omission of the L.N.E.R. lines in Scotland, we must remember that his 40 years of association with the engineering department of the Caledonian and L.M.S. enabled him to write with a detailed knowledge of his own line which inspires confidence. Glasgow, as the centre of the L.M.S.R. in Scotland, receives special attention, both as regards the great bulk of its goods traffic, and also as the gateway to the Clyde Coast passenger traffic which the railway has done much to foster.

Die Wirtschaftliche Notlage der Eisenbahnen in den Nachkriegsjahren und ihre Einwirkung auf die Verkehrspolitik. (The Economic Crisis of Railways in Post-War Years and its Effect on Traffic Policy.) By Nils Gustaf Ehrnrooth. Helsingfors: Frenchellska Tryckeri Aktiebolaget. 9¾ in. × 6¾ in. 242 pp. Folding map. No price marked.—This very richly documented thesis deserves wide recognition as a well-balanced treatment of railway difficulties and transport developments as a whole in Germany, France, England, North America and other countries in so far as their conditions throw light on the general situation. The author has not made the mistake of omitting a concise treatment of the theoretical bases of railway and road transport costs and rates, and the relation of the State to transport problems. However familiar these topics may be to experts, the author's survey is distinctly useful, especially as his footnotes contain numerous quotations from authorities in the original text. Following these introductory sections, more than half the book is devoted to the consideration of general and specific causes of railway crisis, including the general upheaval of financial affairs, taxation, obsolescence, defective organisation, over-capitalisation, and the various phases of competition—between markets, and between railways and other railways, shipping, pipe lines, air transport and road transport. On all these topics the author presents a systematic analysis of the course of events and conditions, together with brief statements of relevant statistics.

Measures taken by various governments to deal with traffic problems, and defensive measures by the railways themselves, next receive consideration, particular attention being paid to the statutory control and taxation of motor transport, changes in railway legislation, and the trend towards co-ordination of transport. The concluding section, on the traffic policy of railways, covers technical and commercial developments, publicity methods and the inauguration of special railway facilities. The co-ordination of road transport with rail services is discussed in its various aspects and with specific references to developments in all the principal countries. Container traffic, the use of road trucks for railway wagons, railcar developments, and collaboration between railways, air transport and shipping concerns, all receive treatment, and the book ends with a valuable bibliography.

American Railway Signalling Principles and Practices. Chapter XI. Automatic Block Systems. The Signal Section of the Association of American Railroads, 30, Vesey Street, New York City, U.S.A. 34 pp. Price 25 cents.—It has been our pleasure, from time to time, to acknowledge the chapters—now nineteen in number—on the subject named above, that have been prepared for educational purposes by a committee of the Signal Section, A.A.R. The latest chapter, which deals with automatic block systems and incorporates 15 wiring diagrams and plans of lay-outs, is possibly the most useful, in that it covers one of the widest fields in modern signalling. The signals themselves are not described, but the more useful purpose of showing the track circuit connections and the signal controls is carried out very thoroughly, and to the benefit of the student reader for whom these publications are primarily intended.

Plumber's Metal.—A useful leaflet outlining the characteristic of Plumber's Metal, a product of British Insulated Cables Limited, Prescot, Lancs, has been published by the manufacturers in order to show under what conditions this type of solder can be used to the best advantage. Plumber's Metal contains 33·3 per cent. of tin, a proportion which has been found most suitable for all-round work on wiped joints. It is emphasised, however, that its use demands competent technique on the part of the jointer, since a slow workman may have to resort to reheating, which tends to impair the efficiency of the joint when using a solder with a relatively high tin content.

Converters and Transformers.—Bruce, Peebles & Co. Ltd., of Edinburgh, sends an illustrated folder setting out the salient features of rotary converting and mercury arc rectifying plant for railways, tramways, and industrial supply systems. The equipment shown provides typical examples of motor generator and similar apparatus supplied to large undertakings for a variety of heavy duties. Among them are a rectifier rated at 2,500 kW, now in use on the Southern Railway, and a 1,500-kW motor converter for the Tata Iron & Steel Co. Ltd., Jamshedpur, India. Another folder from the same firm gives a general specification of transformers. Special provision is made in these instruments for efficient cooling under humid climatic conditions or extra-high voltages, and to achieve the maximum silence in working.

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THE SCRAP HEAP

One of our railway magistrates (actually a civil magistrate, detailed for the special duty of holding court at a big station, to deal directly with non-paying passengers), had an old man brought before him for the usual offence.

M.—And were you travelling without a ticket?

O.M.—Yes, Sahib.

M.—Why?

O.M.—Sahib, for 29 years have I used this railway, and never have I bought a ticket. Why should I start now?

* * *

The advantage of travelling by train to a convenient starting point for a cycle ride is illustrated in lively fashion by this Great Western Railway photographic poster, reproduced in photogravure and now brightening many stations in "built-up" areas

* * *

Mr. M. W. Thompson, one time Chairman of the Midland Railway Company, was in his day and generation regarded as one of the highest railway authorities in the United Kingdom. In addition to being Chairman of the Midland Company, he presided over the directorate of the Glasgow and South-Western Railway. In his abstinence from politics, Parliament lost in Mr. Thompson a far-seeing statesman. A barrister by profession, he was a brewer by trade. Once, at a compensation case tried in London, he was cross-examined by a young barrister. The youthful limb of Lincoln's Inn asked the grave and modest Yorkshireman who he was. Quoth Mr. Thompson, with quiet force, "When I am in Bradford, I am a brewer; when I am at Guiseley, I am a justice of the peace and a gentleman; when I am at Glasgow, I am Chairman of the South-Western Railway Company; when I am at Derby, I am Chairman of the Midland Railway Company; but when I am in London, I am a barrister, like you, sir!" History is dumb as to the young man's reply. Probably, like the vanquished hero in Bret Harte's poem, "the subsequent proceedings interested him no more."

* * *

AT CHARING CROSS

Youthful member of village party visiting London.—"Come on grandpa, let's go on the Underground."

Grandpa (ponderously).—"When *I* goes underground m'boy it'll be for *good*."

Village postmistress (with asperity).—"Well, I don't suppose any on us goes for *evil*."

Village schoolmaster (pacifying).—Never moind; never moind; we'll *all* stay on *terra firma*.

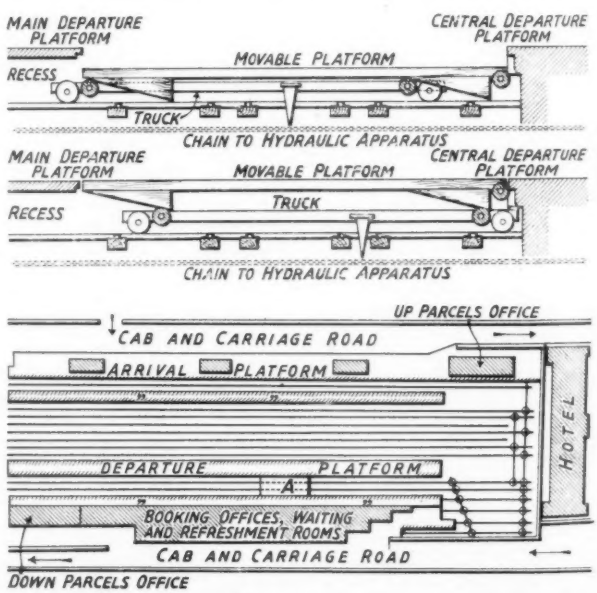
* * *

The following account is extracted from "Railway Appliances" by John Wolfe Barry, published in 1878:—

"At the Great Western station at Paddington, the booking offices are placed by the side of the main departure platform. A piece of cross platform (marked 'A' in one figure and shown in detail in the other), supported on a dwarf truck, is provided, which when required is drawn out by hydraulic machinery from beneath the main departure platform, and rises to the same level as the main platforms, becoming a bridge across the rails, and giving access to the second departure platform. The upper position in the sketch represents the platform drawn out on its truck from the recess by means of a chain connected to an hydraulic apparatus, and the lower position shows it raised to the level of the platforms on each side. The raising is effected by continuing to haul on the chain after the truck has come out of the recess, which causes the two rollers (shaded in the sketches) to travel along the lower surfaces of the inclined planes fixed below the platform. Small rollers at the end of the platform relieve the friction between the movable platform, and the side of the central platform. By the use of this movable platform three long trains can be loaded at once, if the two trains nearest the booking offices be temporarily cut in halves. When it is necessary to despatch these trains, the movable cross platform is run back to its position beneath the main platform, the first half of the train is backed and coupled up to the second half. Trains of shorter length can be loaded and despatched, when the movable platform is raised. The position of the booking offices, near the centre of the departure platform, is no doubt convenient, as passengers approach the train near its centre; and though there is some inconvenience in the use of a movable platform, the arrangement answers well for a terminal station like Paddington, where trains are not very frequent, while the central position of the booking offices is certainly advantageous where the amount of passengers' luggage is large."

* * *

Ramblers from Kamenz (Saxony) took the train for Dresden to join a surprise excursion, one of the weekly "rides into the blue" organised by the Reichsbahn, in which passengers are taken to an unknown destination. The Kamenz party travelled for an hour or two in the special train with 1,700 other excursionists. Then the train stopped at a country station, where the Mayor and a deputation stood on the platform to welcome them. The Kamenzers rubbed their eyes. They were back in Kamenz!



Arrangement of movable connection between two departure platforms at Paddington, G.W.R., in 1878

OVERSEAS RAILWAY AFFAIRS

(*From our special correspondents*)

ARGENTINA

Another Subway for Buenos Aires

The Compañia Hispano Argentina de Obras Publicas y Finanzas, which is at present engaged in constructing the new underground railway from Plaza Constitucion to Retiro, has been officially authorised by the Municipality of Buenos Aires to begin work on a similar line running from Plaza Mayo in the centre of the city to the suburb of Nuñez, situated a short distance outside the northern city boundary. The line will have a total length of 11½ km., will be of double track, and will thus be the longest underground line yet constructed in Buenos Aires. There will be 19 stations, each with platforms measuring 104 m. long, and the total cost of the work is estimated at $65,000,000 paper. It is expected that the first section will be completed by the end of 1936.

B.A.G.S. & B.A.W. Co-ordination

The co-ordination of certain departments of the B.A.G.S and B.A.W. Railways [referred to in THE RAILWAY GAZETTE of June 22, 1934, and March 15 last.—ED. *R.G.*] was formally approved and ratified by a decree of the Ministry of Public Works issued on April 23. After defining the nature and scope of the new arrangement between these two railways and pointing out its advantages both to the companies themselves and to the public, by reducing operating costs and eliminating unnecessary competition, the decree refers to the grouping in 1921 of the British railways into four systems, and to the railway emergency laws passed in the U.S.A. in June last. It also quotes a number of local precedents, including the agreement between the Pacific and Argentine Great Western Railways, approved in 1907 and extended in 1933 for a further 20 years; the placing of the Entre Rios and N.E. Argentine Railways under joint management in 1915 with Government sanction and the merging at various times between 1900 and 1913 of several small lines into the system comprised in the Cordoba Central Railway. The decree makes it quite clear that the arrangement between the Southern and Western Railways in no way infringes either Law No. 5315 (Mitre Law) nor the provisions of Law 2873 (Art. 67) which prohibits railways serving the same zone from concluding agreements in regard to special tariffs or pooling their receipts. Both the laws quoted referred to the merging of companies in such a way that they became one concern under a single management; but in the present case the two railways concerned retained their separate individualities, and neither their receipts nor their accounts would be amalgamated; consequently the sanction of Congress for the measure adopted was not necessary. No definite merger could be deemed to exist so long as the accountancy systems remained independent and could be controlled separately by the Government.

CHILE

Technical Council for the State Railways

According to information from Chile, one of the subjects to be dealt with during the coming sessions of Congress is that of re-establishing a Technical Council for the State Railways. It is stated that the majority of the railwaymen want the council, on which they can have their own representatives, thus ensuring attention to their demands. It is reported, however, that there is a strong body of public opinion against the restoration of the council on the grounds that its previous existence led to the demoralisation of the service owing to lack of proper direction. For this reason it was abolished and a Director-General appointed with complete authority, a policy which, it is urged, has proved very successful in promoting the efficiency and economic control of the State Railways.

NEW ZEALAND

Mr. Sterling's Tour

The Prime Minister recently announced that Mr. H. H. Sterling, Chairman of the New Zealand Government Railways Board, would leave the Dominion, on a world tour of investigation into railway and other transport developments, about the end of April. He also emphasized the necessity for keeping up to date in such matters and remarked that, but for the economic situation, the Government had intended him to make this tour some years ago. Mr. Sterling will visit America, and then England and other European countries, and is not expected to be back in New Zealand before the beginning of 1936.

Returning Prosperity

The upward movement in rail-borne goods traffic all over New Zealand is a sure sign of returning prosperity. At New Plymouth, for instance, there has been unprecedented traffic movement lately; special trains have been run daily and the train staffs have been working long hours. Calls for extra trucks to handle refrigerated produce have been made on Wanganui and Wellington, and altogether about 100 of these have been kept in continuous activity. The number of trucks of all sorts handled daily has averaged well over 200.

INDIA

Capital Programme, 1935-36 : B.B. & C.I.R.

The net allotment for the Capital and Depreciation Fund programme on the Bombay, Baroda & Central India Railway for the year 1935-36 amounts to Rs. 188·50 lakhs. The whole expenditure is concerned with rolling stock and other open line works, there being no provision for new construction. The rolling stock programme involves an expenditure of Rs. 11·51 lakhs from Capital and Rs. 55·79 lakhs from the Depreciation Fund. The 30 " YF " type metre gauge locomotives, the building of which was begun at the Ajmer shops, will be completed and a provision of about Rs. 4 lakhs is made to enable work to be begun upon 13 other metre gauge locomotives which will be completed next year. A broad gauge diesel electric locomotive is budgeted for at a cost of Rs. 1·09 lakhs. An extensive programme of betterment of coaching and goods stock is contemplated for 1935-36, the budgeted expenditure being Rs. 8·97 from Capital and Rs. 44·56 from the Depreciation Fund.

Track renewals during the year will absorb a sum of Rs. 44·36 lakhs, most of which will be found from the Depreciation Fund. A sum of Rs. 43·04 lakhs is provided for the completion of works in progress, and about Rs. 20 lakhs will be spent on the Nerbudda Bridge at Broach, leaving a small expenditure upon it only for next year. The renewal and strengthening of bridges on the Mhow-Rutlam section will be continued as also the concluding stages of the new locomotive shops at Dohad. The most important new work to be undertaken in 1935-36 is the electrification of Borivli-Virar section in the Bombay suburban area. The estimated cost of this work is Rs. 25·68, of which Rs. 15·66 lakhs will be spent this year. The replacement of certain machinery in the Ajmer workshops will bring the latter up to modern requirements.

DENMARK

The Summer Train Services

Very considerable alterations and improvements of train service in Denmark have followed the opening for traffic, on May 15, of the Little Belt bridge, coupled with the introduction of high speed diesel trains or Lyntog services, as they are known. Three of these three-coach articulated units have been brought into service, and each one is named. The Vestjyden service runs between Copenhagen and Esbjerg, there connecting with the steamers to and from Parkeston Quay

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(Harwich). By its use, departure from Copenhagen is delayed from 9.20 until 11.45 a.m., giving the business man ample time at his office for transacting business before leaving for England. In the opposite direction, by starting the boat train from Liverpool Street, London, at 4.10 instead of 7.42 p.m., the steamer reaches Esbjerg sufficiently early to permit the Vestjyden train to bring its passengers into Copenhagen at 11.55 p.m., instead of the following morning. No stops are publicly advertised between Copenhagen and Esbjerg, and the only stops actually made are at Korsor and Nyborg, where transfer to and from the Great Belt train-ferry takes place. The total distance between Copenhagen and Esbjerg is 193¾ miles, but as the 16-mile crossing of the Great Belt accounts in all for roughly 1½ hr., the average running speed of the Vestjyden, which takes 4 hr. 34 min. westbound and 4¾ hr. eastbound, is but very little under 60 m.p.h. It is also all but 2¼ hr. quicker than the best previous steam service, which crossed the now abandoned Little Belt ferry.

Copenhagen-North Jutland Service

The second diesel-driven train is the Kronjyden, leaving Copenhagen at 8 a.m. for Aarhus, Randers, and Aalborg, which is reached at 2.25 p.m. Aarhus is the first publicly-booked stop, and the 123·1-mile run from Nyborg to Aarhus is the first 100-mile non-stop journey to appear in the Danish timetables. It is made in 126 min., at an average of 58·6 m.p.h., and in the reverse direction in 124 min., at 59·5 m.p.h. The time allowed for the 68·4 miles from Copenhagen to Korsor, as with the Vestjyden, is 69 min., and in the reverse direction 70 min., giving speeds of 59·5 and 58·6 m.p.h. respectively. The return journey is begun from Aalborg at 5.5 p.m., and Copenhagen is reached at 11.45 p.m. The time of 4 hr. 36 min. from Copenhagen to Aarhus (207¼ miles) compares with a best time of 7 hr. 17 min. previously. The total journey is one of 294¼ miles in each direction daily.

The same route as far as Aarhus is followed by the third unit—the Ostjyden—but with numerous stops; it leaves Copenhagen at 8.10 a.m., reaches Aarhus at 1.25 p.m., starts back at 5.45 p.m., and is due in Copenhagen at 10.55 p.m. This train makes the fastest booked run in Denmark, from Roskilde to Slagelse, 38·3 miles in 38 min., at 60·4 m.p.h. from start to stop, and most of the timings are at but little lower speeds.

A New Steamer-Rail Service

Another innovation is a service twice daily between Copenhagen and Aarhus via Kalundborg, with a direct steamer connection between Kalundborg and Aarhus, in an overall journey time of approximately 6 hr. Hitherto the quickest time by rail throughout from Copenhagen to Aarhus (including two train-ferry crossings) has been 6 hr. 50 min.

International Services Improved

The improved communication with the mainland of Jutland afforded by the new bridge has also been used to improve international communications. Among them, the through sleeping car between Paris and Copenhagen, on the Nord express service, has been restored. Leaving Paris at 7.15 p.m., this is due in Copenhagen at 7.14 p.m. the next day, via Hamburg and Schleswig: in the opposite direction, Copenhagen is left at 9.10 a.m. and Paris reached at 10.49 a.m. The other through services to and from Hamburg are also improved. Connecting with the through express from Oslo and Gothenburg, a through sleeping car for Hamburg leaves Elsinore at 9.5 p.m., and Copenhagen at 9.45 p.m., and is worked attached to a diesel rail-train as far as Korsor, there overtaking the 8.10 p.m. sleeping car train from Copenhagen. In this way the previous fastest time from Copenhagen to Hamburg by this route—over 12 hr.—has been reduced to 10 hr. 6 min., and the communication between Norway, Sweden, and North Germany has been expedited. At Fredericia this train joins another express from Frederickshavn, in the extreme north of Jutland, connecting with the direct steamer service from Gothenburg and Aarhus, and similarly carrying a through sleeping car for Hamburg: it also is considerably accelerated.

Extent of Improvements

A measure of the Danish improvements is given by the fact that, as compared with the last previous timetables, an aggregate saving of 2,200 minutes has been effected. Up to and including the year 1930, only 77 miles were scheduled daily at as high a speed as 43½ m.p.h., and 1,045 miles at 40 m.p.h.; by 1935 these figures have risen to 2,612 and 4,535 miles respectively, while 1,241 miles are booked at 50 m.p.h. or over, and 497 miles at 58 m.p.h. or over.

SWITZERLAND

Press Comments on the Rail and Road Bill Referendum

On page 941 in THE RAILWAY GAZETTE of May 10, the result of the Swiss national referendum upon the Road and Rail Bill was recorded. Although the rejection of the measure was not wholly unexpected, the heavy adverse vote against it came as a surprise. The following are some of the principal reasons advanced by the Swiss press in explanation of the complete defeat of the Bill:—

The Socialist Party contends that the proposed law did not solve the real difficulties of the situation as it did not go far enough in establishing a State monopoly as regards either the railways or road transport. The fact that the measure would also have resulted in a number of railwaymen losing their jobs made it unpopular with the Socialists.

On the other hand private bodies and interested parties voted against the measure on the grounds that it extended State control. Moreover, a great many people opposed the Bill in order to censure the administration of the railways and also in the belief that it was imperative for the railways to be completely reorganised and that half measures were of practically no value. A point to bear in mind is the prevailing attitude of the Swiss public towards any suggestions emanating from the Federal Government: it has now become a practice to vote against any law introduced by the Berne Government, so that within the last few years only one referendum—relative to military organisation—obtained a majority in favour of the Government. The *Neue Zürcher Zeitung* is of the opinion that the Government was not sufficiently active in supporting the referendum and that the whole matter developed into a campaign between rail and road undertakings.

All these criticisms have placed the Federal Authorities in a difficult position and it is thought that they will now await the result of the "*initiative*" regarding the removal of the Federal Railways from the sphere of political influence before making any further decisions. The *initiative de dépolitisation des chemins de fer fédéraux* will in all probability be submitted to a referendum in the autumn. Meanwhile the railway deficit continues to increase: its total for the years 1931 to 1934 was Swiss fr. 132 million, the deficit for 1934 amounted to fr. 43 million, and that anticipated for 1935 is Swiss fr. 50 million.

ITALY

Special Period Ticket Fares

We reported at the time of their institution the issue of tickets available for periods of 8 and 15 days for any number of journeys throughout the entire State Railways system. The administration has now decided to allow a reduction of 50 per cent. on the price of these tickets to all foreigners visiting Italy. No formalities beyond the presentation of passports are required, and the tickets are to be issued at the frontier stations and at all offices of the C.I.T. and the principal tourist agencies abroad. The fares charged for these new tickets are: first class about £12 16s., second class about £10, and third class about £6 3s. for 15 days. The corresponding fares for eight days are £10 5s., £6 11s., and £5 respectively. On payment of a small supplement the tickets are available by any express train for which a supplement is normally collected, and the 15-day tickets may be renewed up to a further period of 15 days on payment of one-fifteenth of the original price for each day of extension.

OUR CENTENARY—MESSAGES FROM READERS

As announced in our May 3 issue, " The Railway Gazette " and the journals incorporated with it have completed 100 years of continuous publication

THE following is the fourth instalment of the many messages we have received in connection with the centenary of THE RAILWAY GAZETTE and the various railway journals now incorporated with it, the earliest of which made its first appearance on May 1, 1835. In expressing our thanks to all who have written, may we say how greatly we value their appreciative and encouraging messages.

Mr. C. B. Anderson, Railways Commissioner, South Australian Government Railways, Adelaide.

May I offer you my congratulations on the completion of 100 years of continuous publication of THE RAILWAY GAZETTE and the journals now incorporated with it, and express my sincere good wishes for its future ?

We have been subscribing to your GAZETTE for a great many years, copies being circulated throughout all branches of these railways for the information of the principal officers, and a file always available for the staff at the Railways Institute.

Features which have especially appealed to us have been the record of scientific achievements as relating to railways, and the special supplements, notably in connection with diesel engines, which are incorporated.

Mr. F. McCormick, Manager, The Emu Bay Railway Co. Ltd., Burnie, Tasmania.

We take the opportunity of congratulating THE RAILWAY GAZETTE on having " run " for 100 years non-stop, and always on time ; truly a wonderful railway performance and something to be proud of. From the Antipodes we wish it another century, a " full head of steam," and a perfect " running top."

Mr. H. H. Grindley, General Manager, Central Uruguay Railway Company, Montevideo.

In my opinion, THE RAILWAY GAZETTE, though interesting to the layman, is of incalculable value to the professional railwayman whose vision is not confined within the four walls of his own office.

By the universal nature of its articles it informs him in general terms of developments in the technique of his profession and also as to the source from which further and more detailed information is obtainable. In other words, besides stimulating the desire to learn, it tells him how to acquire the knowledge he seeks. THE RAILWAY GAZETTE is circulated officially to all the chief officers and senior staff, both administrative and departmental, of this railway, and quite frequently officers are asked to report officially as to the possible application to this railway of methods or equipment described in THE RAILWAY GAZETTE.

It is difficult to say which features of the GAZETTE are the most interesting, but certainly the reports of speeches delivered by the chairmen of the great railways are by no means the least interesting. Perhaps, naturally, I would like to see more space allotted to overseas railways whose characteristics and conditions bear more similarity to one another and, therefore, are more useful for comparative purposes to those responsible for the management and operation of British owned railways abroad (which represent a huge capital of British money) than are those of the great British groups. I sometimes think, for instance, that the world ought to know more about the great Indian and Argentine (British owned) railways.

Sir Sam Fay, Director, Buenos Ayres Great Southern Railway.

As a reader of THE RAILWAY GAZETTE and its incorporated journals for more than half of your century, I can testify to its value—and a very big value it has been—to railway men by the publication of inventions, forms of management, construction and operation in all parts of the world.

I have a recollection of journeying to Hungary 27 years ago to inspect a successful installation of a petrol electric passenger service between Arad, Temesvar, and the Iron Gate of which I should have been ignorant but for THE RAILWAY GAZETTE.

This is simply an incident which I am sure many of your subscribers could match in their search for railway perfection. Long may you flourish.

Mr. C. A. Muirhead, Agent, South Indian Railway Co. Ltd., Trichinopoly.

In offering my congratulations on the centenary of your paper I have to say that there is no technical publication which embraces such a large field of railway subjects as yours. There is hardly an issue which does not contain articles of interest both to the technical and operating departments of railway administration. The addition of the supplements dealing with electric and diesel traction is of particular interest just now when these forms of traction have appeared as serious rivals to steam traction. I wish your paper a long and prosperous future.

Mr. C. S. Schmidt, Controller and Auditor-General, Union of South Africa, Pretoria.

I congratulate THE RAILWAY GAZETTE on the attainment of its centenary. Its comprehensive survey of modern transport from every angle, in all parts of the world, is both instructive and inspiring.

The variety of its illustrations, the wealth of data and diagram, its concise literary style, make an appeal to the specialist in railway affairs or to any casual reader. The articles published from time to time bearing on railway finance are of particular interest to me in my capacity as Controller and Auditor-General of the Union of South Africa.

M. B. d'Welles, Ingéniéur en Chef du Service Central de l'Exploitation du P.O.-Midi.

I am very happy to send you my most sincere congratulations on the centenary of your journal. Every week renews my pleasure by reading it. I am always surprised to experience in what a manner your staff succeeds in rousing interest of the reader by announcing and commenting upon developments and progress of every railway in the world. Surety, precision, recency of information, living management, perfection of drawings and photographs are characteristic features of your issues. I am particularly interested in your critical articles concerning accidents. No technical review in France would be daring to meet such ticklish matters, chiefly with full frankness and leisure as you are accustomed to. Yet these inquiries are most instructive for every railway officer. I trust THE RAILWAY GAZETTE may continue for many years its successful career.

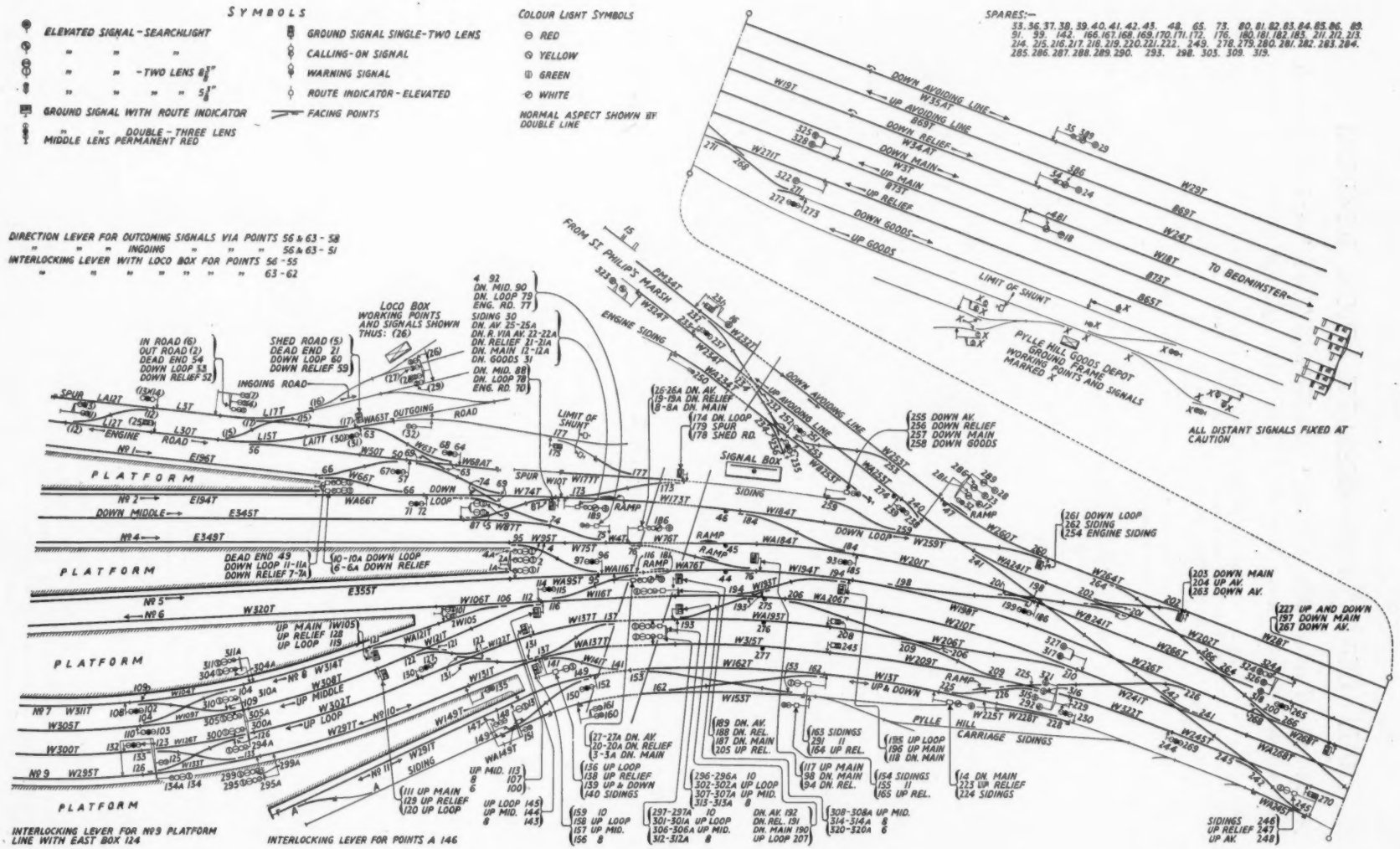
Mr. A. F. Wallis, Honorary Secretary, Railway Students' Association, London.

Please accept our heartiest congratulations upon attaining a century of unrivalled success in railway journalism. Whilst THE RAILWAY GAZETTE is the official organ of railway news, this very function has, in itself, played no small part in the educational aspect of railway service all over the world. I have no doubt that this is especially the case in regard to the technical and salaried staffs of the British railways who have never failed to find within its pages, week by week, the information they require.

We have been cognisant of the very liberal space afforded for reports of the various activities of educational societies associated with railway and general transport, and for bringing before the rising generation of railwaymen the importance of becoming fully equipped to meet the ever-growing transport problems of this country.

Yours is a record of which you may be justly proud, and we wish you every prosperity in the years to come.

XUM


SYMBOLS
ELEVATED SIGNAL - SEARCHLIGHT
" " "
" " - TWO LENS 8" "
" " " " 5" "
GROUND SIGNAL WITH ROUTE INDICATOR
" " DOUBLE - THREE LENS
MIDDLE LENS PERMANENT RED
GROUND SIGNAL SINGLE - TWO LENS
CALLING - ON SIGNAL
WARNING SIGNAL
ROUTE INDICATOR - ELEVATED
FACING POINTS
COLOUR LIGHT SYMBOLS
RED
YELLOW
GREEN
WHITE
NORMAL ASPECT SHOWN BY DOUBLE LINE
SPARES:-
33. 36. 37. 38. 39. 40. 41. 42. 43. 48. 65. 73. 80. 81. 82. 83. 84. 85. 86. 89. 91. 99. 142. 166. 167. 168. 169. 170. 171. 172. 176. 180. 181. 182. 183. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 249. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 293. 298. 305. 309. 319.
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UP AVOIDING LINE
DOWN RELIEF
DOWN MAIN
UP MAIN
UP RELIEF
DOWN GOODS
UP GOODS
LIMIT OF SHUNT
TO BEDMINSTER
PYLLE HILL GOODS DEPOT
GROUND FRAME
WORKING POINTS AND SIGNALS
MARKED X
ALL DISTANT SIGNALS FIXED AT CAUTION
FROM ST PHILIP'S MARSH
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DOWN RELIEF 7-2A
10-10A DOWN LOOP
6-6A DOWN RELIEF
UP MAIN 1W105
UP RELIEF 128
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UP MIDDLE
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Signalling diagram of the west end of Temple Meads, Bristol

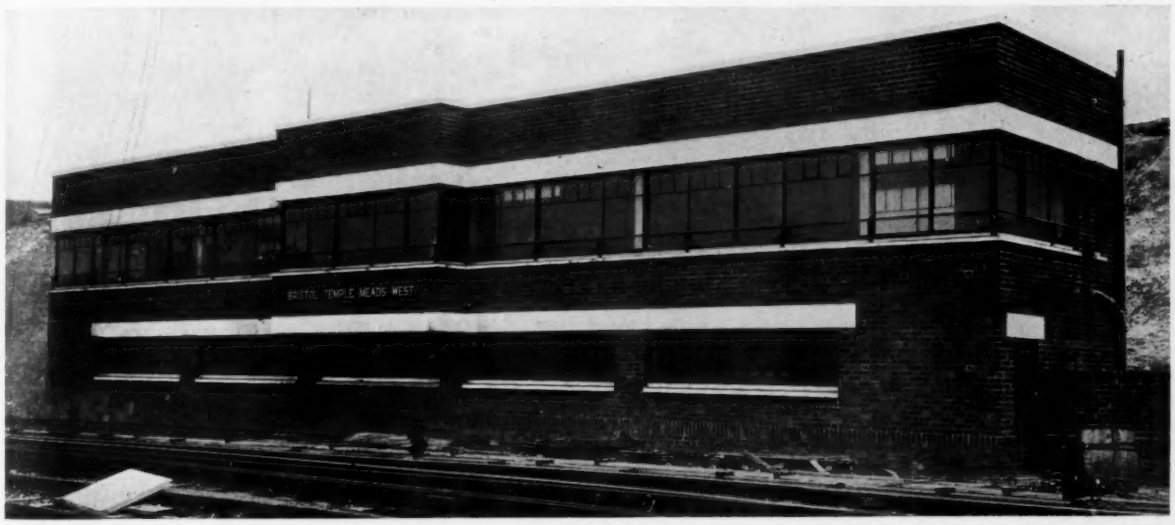
RE-SIGNALLING OF TEMPLE MEADS STATION, BRISTOL, G.W.R.

Of the three power-operated boxes included in the scheme, the West box is now completed; the Loco. Yard box was opened in December last; and the East box will be brought into use later this year

THE re-signalling now being undertaken by the G.W.R. at Bristol requires the provision of three power-operated signal boxes, namely, Temple Meads East, with 368 levers; Temple Meads West, with 328 levers; and Bristol Locomotive Yard, with 32 levers; a total of 728 levers and therefore the largest power installation in the country. Electric power is used for the operation of signals and points, and the locking frames are wholly electrically interlocked. The Locomotive Yard box was opened in December last; the West box is now completed; and the East box will follow later this year. When the work is completed five mechanically-operated boxes, with an aggregate of 327 levers, will have been dispensed with. An idea of the magnitude of the work and of the general scheme can be obtained from the diagram of the West box reproduced herewith.

The points are actuated from a 120-volt 240 ampere-hour battery. As seen on the left of the illustration on p. 1066, showing a typical signal, the point machines are fixed in the "six-foot" and are secured to the track by long tie-plates. The bolting and detection of the points are made through extensions from the switches to the interior of the mechanism. Dynamic braking is provided, with cross-protection and superimposed a.c. for point detection. The machines permit of local operation by a hand-crank in case of current failure or other similar emergency.

All running signals are of the colour-light type; those requiring a long range are of the searchlight pattern, but throughout the station they are of the multi-lens type, with short-range, wide-angle lenses. In accordance with Great Western standard practice—in order to conform to what the drivers have been used to in semaphore signalling—the searchlight signals have an upper and a lower unit; the upper may be considered as corresponding to the stop arm of a two-arm signal and the lower unit gives the yellow or green of a distant signal. The route indicators, where employed, are of the compartment type, as shown in the top right-hand illustration on page 818 of our issue of December 1, 1933, when describing the re-signalling of Paddington station. The signal gantries and brackets, which are of all-steel construction, were made in the railway company's signal works at Reading, and the signalling contractors supplied and fixed the tubular dolls and fittings.



Exterior of Bristol, Temple Meads West box

The signal boxes are of steel-framed, brick construction, with pre-cast floors. The inside of the walls of the upper floors are tiled up to the window sills and the floors are of polished oak boards. The East and West boxes will be centrally-heated by a low-pressure hot-water system; the Locomotive Yard box is heated electrically. We give views of the exterior of the two larger boxes. The East box has a ground, middle floor and top floor. The last is the operating floor and carries the locking frame. The relays, relay racks, switchboard, and similar equipment are on the middle floor, whilst the ground floor accommodates the linemen, linemen's stores, &c. The relays, switchboard, and other gear are on the ground floor at the West and Locomotive Yard boxes.

We give views of the interior of the completed Locomotive Yard box and of the front and back of the 368-lever frame in the East box. The lever handles, it will be seen, alternately point upwards and downwards, and so give the signalman more space for grasping them. The repeaters for the points and signals are at the top of the panel behind the lever handles. The push-buttons seen in the East box frame are for use to actuate a calling-on signal should track conditions prevent the lever, when moved to reverse, actuating the main signal under its control. There are 18 such push-buttons in the East box and 39 in the West.

Approach, sectional, track, and release route locking is used throughout the installation. The track circuits are

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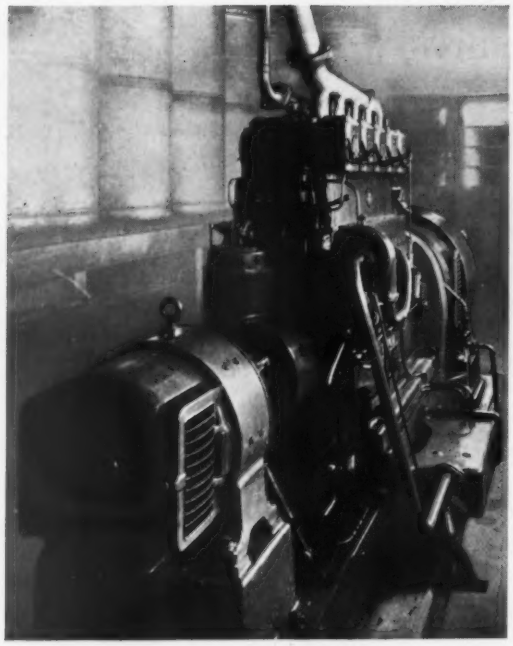
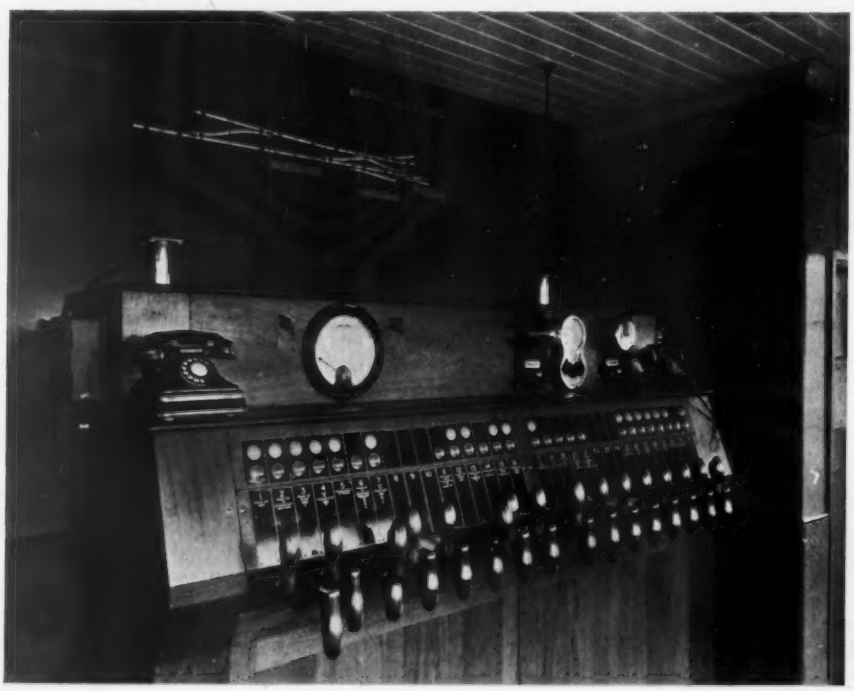


Diesel-driven stand-by plant

Back of interlocking frame, East box

of the condenser-fed, a.c. type, using a rotor form of relay. The condenser is connected in the primary feed of the track transformer and has a capacity variable from 0 to 5 microfads.

The main power supply comes from the railway company's sub-station that provides lighting and power for the station. A second supply is derived from the City Corporation's mains, for which a power-house has been provided near the East box. Therein is a high-tension cubicle for the Corporation supply, together with battery and switchgear rooms. Another power-house, the interior of which we illustrate, has been erected at the West box. This contains a diesel-driven stand-by plant which would supply the whole installation should necessity arise. There



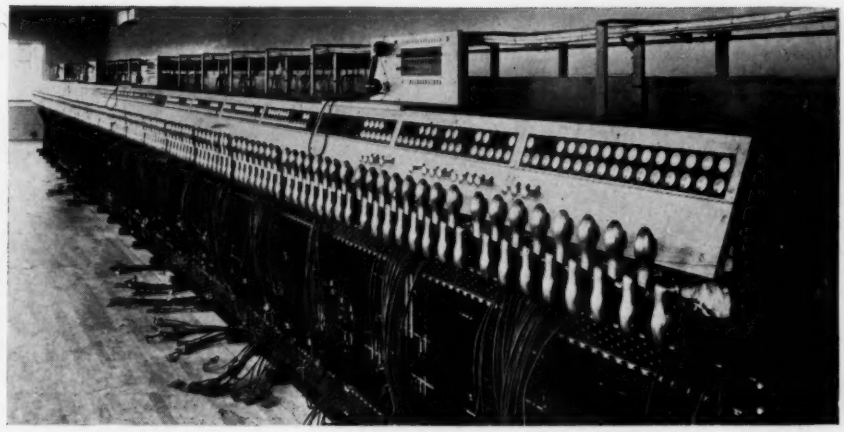
Locking frame of 32 levers, Bristol Loco. Yard box

Typical searchlight signal

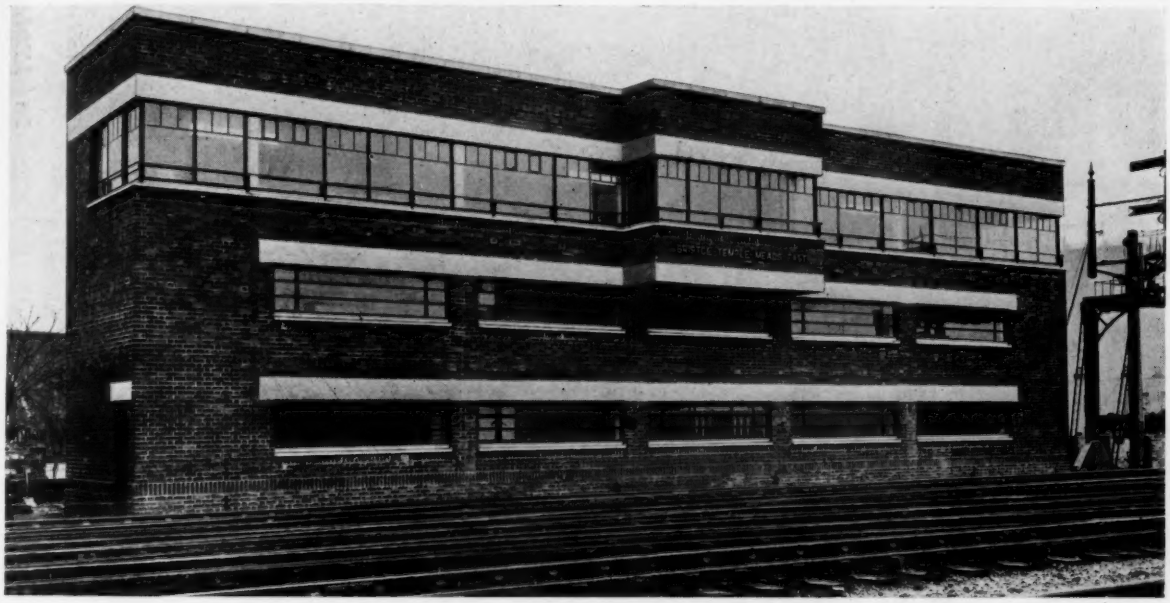
is also a separate battery and switch room in the West box.

The cables, which were supplied as a sub-contract by Callender's Cable & Construction Co. Ltd., are of the lead-covered, impregnated-paper, multicore type, and are armoured where necessary. They are terminated on porcelain bases in welded sheet-steel apparatus cases, which also house the track apparatus.

The main contractor for the signal installation is the General Railway Signal Co. Ltd., and the work is being carried out to plans and specifications prepared by Mr. C. M. Jacobs, the railway company's Signal Engineer.

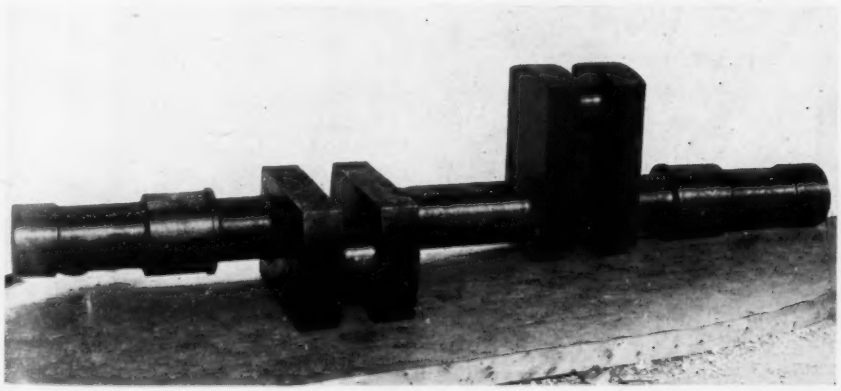


Front view of electric interlocking frame, East box



Exterior of Bristol, Temple Meads East box

A Remarkable Locomotive Crankshaft



The crankshaft illustrated alongside is not exceptional in appearance and bears no indication that it has broken a world's record as far as is known, but actually it is a remarkable example of British workmanship, having run over a million miles in service as part of a locomotive in the Egyptian State Railways. The crankshaft was made in 1891 by Steel, Peech & Tozer Ltd., which is now part of the United Steel Companies Ltd. group, and was in continuous service in Egypt from 1891 to 1934. It has not been touched after being received from Egypt, except for cleaning, and shows a remarkably small amount of wear. The photograph reproduced has not been retouched

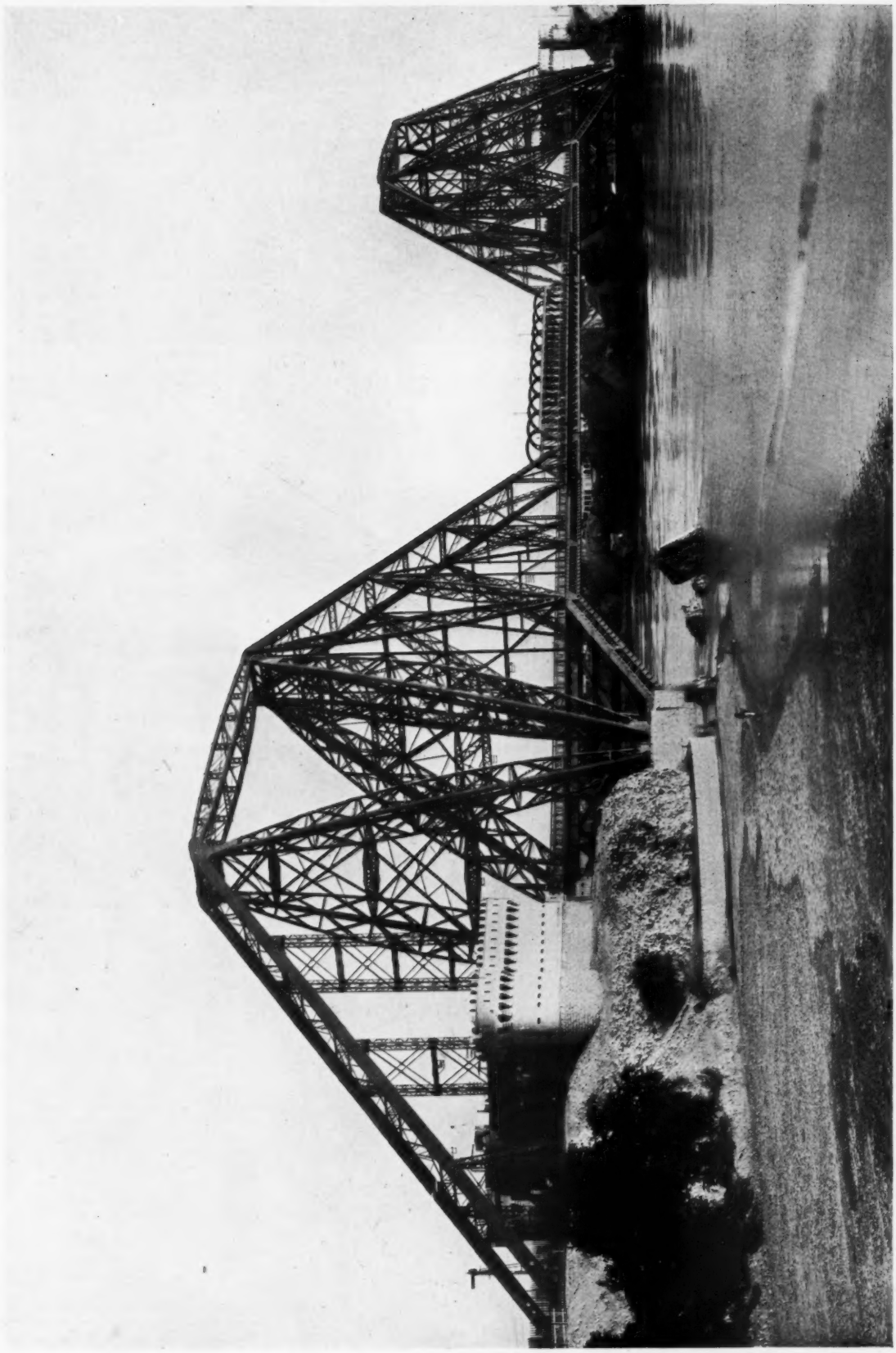


Fig. 19—Lansdowne Bridge across the Indus, near Sukkur. This single 790-ft. clear span was opened to rail and road traffic in 1889, the year before the opening of the Forth Bridge

RECENT PRACTICE IN TESTING OF BRIDGES IN INDIA

*Part II—A description of various tests in Classes 1 and 2, including the Lansdowne cantilever bridge at Sukkur and a special reinforced concrete test: also remarks upon general conditions of testing**

DEALING first with Class 1 tests, it may be mentioned that there are three standard loadings, first adopted in India in 1926 and now in general use on the 5 ft. 6 in. gauge railways in India. They are:—

I.—Heavy Mineral Standard.—This consists of coupled 2-10-2 tender locomotives, having 28-ton driving axle loads and followed by a uniformly distributed load of 2·3 tons per foot run.

II.—Main Line Standard.—This consists of coupled Mikado type tender locomotives having 22½-ton axle loads followed by a uniformly distributed load of 2·3 tons per foot run.

III.—Branch Line Standard.—This consists of coupled Mikado type tender locomotives having 17-ton axle loads followed by a uniformly distributed load of 1·5 tons per foot run.

The general policy for bringing bridgework up to the required strength has been as follows:—

For Main Lines.—Those existing spans which can be economically strengthened are brought up to main line standard, while those which are unsuitable for strengthening are replaced by new spans or other reconditioned spans to heavy mineral standard loading.

For Branch Lines.—Spans which are suitable for strengthening are brought up to branch line standard, while those which cannot be economically strengthened are replaced by spans to main line standard loading.

Pursuing this policy, renewal programmes have been drawn up for the various sections of line, in the case of the North Western Railway, after systematic inspection, field sketching, calculation of strength and compiling the records for all bridges on the railway. As a rule, main lines and more important branch lines have been dealt with first as funds have become available. Exceptions have, of course, been made in the cases of bridges showing serious defects and weakness under the existing loads. In many instances, more particularly in the case of important and costly structures, special tests with extensometers and special equipment have been carried out before any important decision has been made to renew a large bridge. One instance of this kind was an investigation of the strength of the Lansdowne Bridge at Sukkur, which was undertaken some time ago by Mr. W. T. Everall, O.B.E., M.Inst.C.E., Deputy Chief Engineer (Bridges), North Western Railway, in collaboration with the Consulting Engineers, Messrs. Rendel, Palmer & Tritton.

Testing the Lansdowne Bridge at Sukkur, N.W.R.

This bridge, which has a clear span between abutments of 790 ft., is illustrated in Fig. 19. It was opened to traffic in 1889 and the erection occupied nearly two years. The main backstays are anchored into foundations unconnected except through the ground to the main steel structure, and they are subject to alterations in length due to the very large variation in temperature at site, and this causes both cantilever arms to move, each nose moving downwards with increase of temperature. In this bridge no pin connections are used, all intersections of main members being riveted, and bending moments are induced which are of important magnitude at the common intersection of the three large struts at each abutment bearing.

As a first step in analysing the stress in this bridge the Consulting Engineers prepared a stress sheet for all members under dead load, combined with the maximum live load required for present conditions. The stresses under this live load were then verified for certain members by extensometer tests, using Fereday-Palmer stress recorders, Figs. 8, 9 and 10. The Bridge Engineer in India then proceeded with the determination of the temperature stresses. After a few preliminary experiments had been made, the procedure adopted was as follows:—

The structure was drilled and tapped at instrument stations on members subjected to large bending stresses due to temperature variations, to take small hardened steel plugs to suit the gauge points of the Fereday-Palmer stress recorders. The Invar gauge bar (see Fig. 11) was placed conveniently near to the instrument stations where the structure was also drilled with one ¼-in. hole at each station to act as a mercury thermometer pocket. Starting in the early hours before dawn, the following hourly observations were made throughout one period of 24 hours.

1.—Temperature of backstays.
2.—Shade temperature.
3.—Steel temperature at instrument stations.
4.—Visual reading of Fereday-Palmer stress recorder on Invar gauge bar.
5.—Visual reading of Fereday-Palmer stress recorder on structure at each instrument station.

The change in stress due to temperature after each hourly interval was calculated from the stress recorder observations, taking the early morning readings as a datum by first applying corrections for: (*a*) the thermal expansion of the member between plugs at instrument stations estimated from change in thermometer readings in mercury pockets placed there, and (*b*) the thermal expansion of the stress recorder indicated by fluctuation in its reading when on the Invar gauge bar.

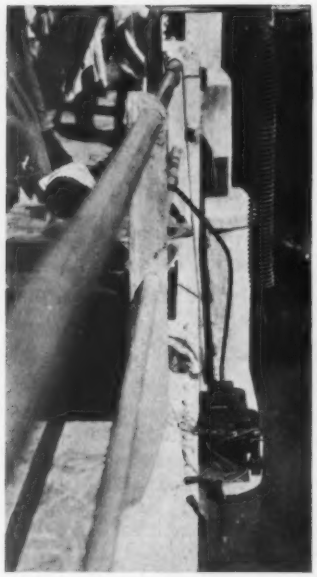
The tests were carried out in the Spring, when great daily temperature variation occurs and the results enabled the range of temperature stress throughout the year to be exterpolated, and this was found to reach two tons per sq. in. in the inclined main strut with parallel flanges. The correct amount of stress to be added to the dead and live loads could not, however, be exactly determined as the temperature conditions when the cantilevers were riveted up are unknown.

In general the inspection of a large span to determine its standard of strength includes the following work:—

(*a*) A survey under dead load of camber, vertical and horizontal distortions of all main members.
(*b*) A measurement of the amount of corrosion in important members. Chemical analyses and mechanical tests of samples of steel taken from the structures. Tests of the tightness of rivets in joints carrying calculated stress.
(*c*) An inspection to determine the efficiency of the end bearings.

Live Load Tests.—These are similar in character to those for tests in Class 2 described below, but in the more obsolescent types, which have a low $\frac{\text{depth}}{\text{span}}$ ratio, special attention is given to the live load deflection, which must not exceed $\frac{L}{1{,}600 + 4L}$ ft. where L is the effective span in feet. The stability of compression members and those subject to alternating and secondary stresses is also

* Part I of this series of articles was published in our issue of March 29; in it are Figs. 1-18.



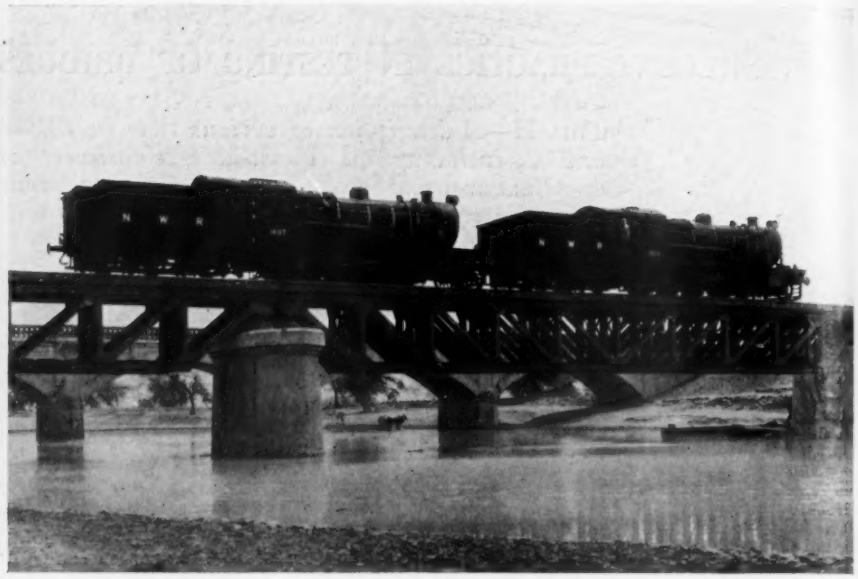


Fig. 20 (left)—Close-coiled 4 in. dia. spring for tensioning wire to operate deflectometer on high bridges. Fig. 21 (right)—Testing 100-ft. clear spans of Tangri Bridge on Delhi-Ambala section, N.W.R., after strengthening by quadruplicating girders. Test load consists of two 2-8-0 type "H.G/S" locomotives with 17-ton axle loads, coupled together

given careful consideration and, if necessary, special extensometer tests are made.

Class 2 Tests

Official instructions to the Senior Government Inspector, whose duty it is to test and certify that a newly constructed or reconstructed bridge is safe for the public carriage of passengers, are contained in the Government of India, 1933 Bridge Rules, published by the Government Press, Delhi, price 1s. 6d. The procedure for inspection and test is outlined as follows:—

The inspector examines at least one bridge of each different type to satisfy himself, so far as practicable, as regards its design generally, that the different portions of the structure are properly designed for the work they are intended to perform, that the construction and erection of all steel work has been properly executed and that the whole structure has been made and assembled correctly.

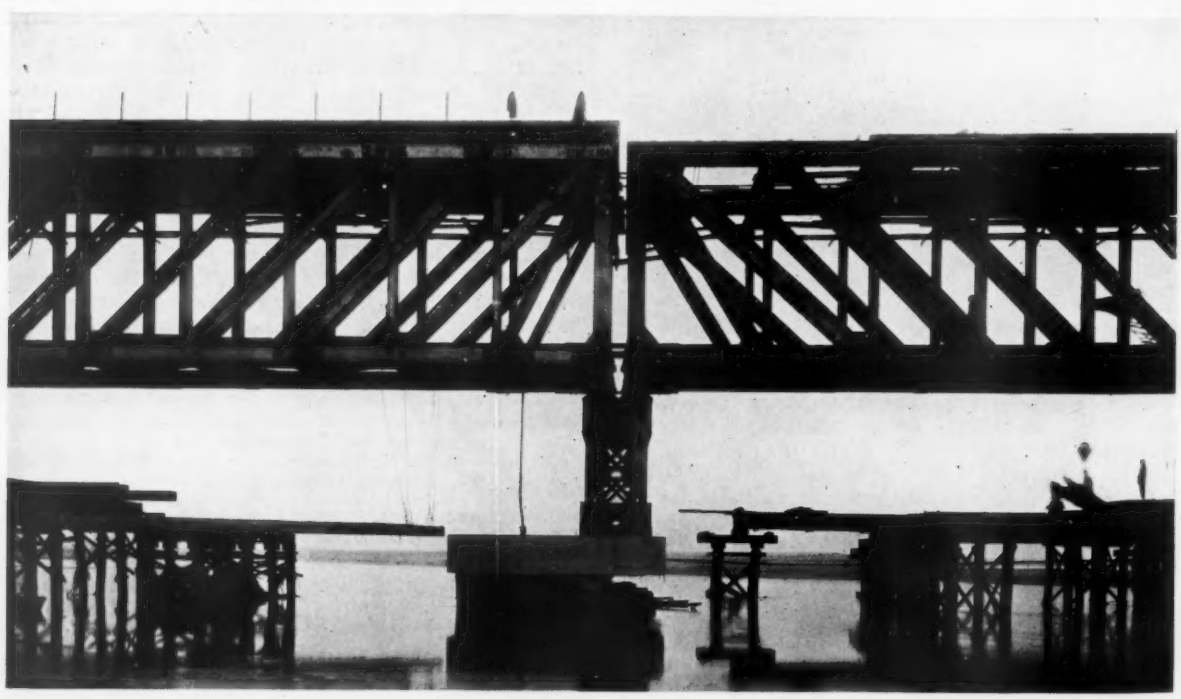


Fig. 22—Reinforced concrete cap for well No. 4, Chenab Bridge, near Chiniot, N.W.R. The photograph was taken while the brick steining was undercut below toe of well cap

He must particularly satisfy himself that the girder spans are properly seated at all bed plates. To ensure this, preliminary card tests under live load at all bearings are made by the officer who has carried out the erection or renewal of spans and masonry, and the cards are carefully scrutinised before the bridge is considered safe for high speeds.

Should the Inspector see cause to believe that any riveting has been improperly or inefficiently executed, he may at his discretion have any rivets cut out for examination. He may also have any part of the structure removed or dismantled for more detailed inspection. Tests may be carried out on any number of spans in addition to the minimum specified above, and the Inspector may test any span any number of times and at any speed up to a maximum of 60 m.p.h. or at the maximum speed of the section. The labour required to carry out the tests is provided by and supervised by the Bridge Department of the railway. The testing train is made up with the heaviest axle loads available or permissible on the section, so as to give as far as possible, a loading equivalent to that for which the span is designed and must be of such a length that the total wheelbase is greater than the span to be tested.

Tests Described

The object of the tests is to record the actual deflections or working stresses under a given loading and in special cases to compare them with the calculated deflections or stresses under this loading. The test train is run over the span at crawling speed in the case of girders which have already been subjected to live load. In other cases it is brought to rest in such a position as to bring the heaviest stress in the girders, and after one minute it is moved on slowly clear of the span and measurements of girder camber before and after the test are made. The speed attained in the high speed tests which follow is measured on the stress recorder and deflectometer records given by the wheel tread contact switch markings (see Figs. 3 to 8 and 10) where such records are taken. In other cases a stop watch is used.

The diameter of the locomotive driving wheels and the out of balance " hammer blow " is also recorded. In the case of deflection tests, the cards are placed as explained above. Where the height of the girders above bed level is very great and a deflectometer is used, the arrangement of the deflectometer wire is somewhat different. The lower end of a No. 16 S.W.G. piano wire, suspended vertically, is attached to a heavy weight below the girder resting on the bed at mid-span. The other end of the wire is attached well above the deflectometer to the lower end of a close coiled helical spring about 4 in. diameter, 4 ft. long, made from ¼-in. steel wire, the upper end of which is attached to the girder at mid-span, and the spring and piano wire are suitably tensioned. The end of a short length of wire from the deflectometer is then clipped to the piano wire. (See Fig. 20.)

In the case of stress tests a stress recorder is applied to the flanges at mid-span and also on such web and floor members as the Inspecting Officer considers desirable. All records are then scrutinised and measured, and the cards and ferro-copies of the deflectometer and stress recorder film records, with completely tabulated measurements, are submitted to the Senior Government Inspector for his approval. Fig. 21 shows a recently strengthened bridge under test. The live load consisted of two H.G./S locomotives (17-ton axle loads) coupled together.

One example of tests on a new reinforced concrete structure of unusual type will now be given. (See Figs. 22 and 23.) Fig. 22 shows one of the twin octagonal wells supporting main spans of the new combined road and rail bridge across the Chenab river at Chiniot. During the early stages of the sinking of this well an unexpected flood in the river caused it to tilt. The tilt was not completely rectified and sinking was proceeded with until the curb reached 94 ft. below low water level, when the tilt had increased to 8 ft. longitudinally and 3 ft. 6 in. transversely. Calculations showed that the well would be stable and not overstressed if a pier were built eccentrically above the well cap, provided that reinforcement were arranged to limit the extreme intensity of compression stress in the well brickwork immediately under the eccentric pier.

The position for the location of the end bearings of the girder was arranged to keep the bending stresses in the well steining down to a safe value. The reinforced concrete cap was assumed to take the dead load of the superstructure erected upon it, a condition assured by undercutting the well brickwork under the toe of the cap, as shown in Fig. 22, to enable the reinforced concrete cantilever to take its stress under the weight of the girders and the trestle which forms a skeleton framework for the eccentric pier, which was completed later.

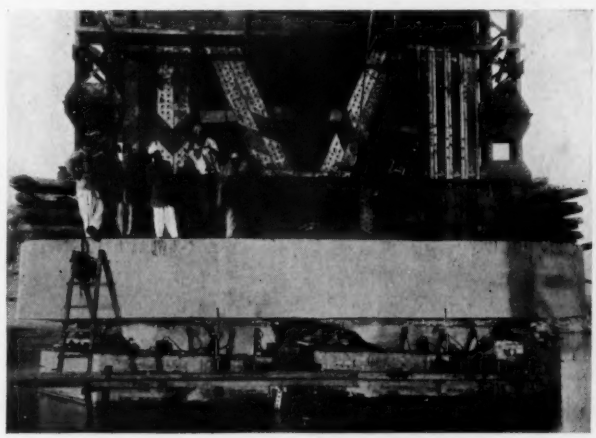


Fig. 23—View of well No. 4 with six stress recorders in position on r.c. and steel stool erected on well cap

After erection of the trestle and girders and the completion of the road-metalling, the undercut brickwork was built up to the underside of the well cap and finally completed by pressure grouting.

At the time of testing, the staging and camber jacks under the spans had not been dismantled. It was therefore possible readily to apply and remove the dead load reactions taken by the trestle and thus provide a test load. This applied load was 430 tons and is 53 per cent. of the total designed load taken by the reinforcement. The stress recorders can be seen in position in Fig. 23. A deflectometer of the Ames dial type was placed under the cantilever nose and Huggenberger extensometers on the tension reinforcement, bared for the purpose near the trestle base. The maximum deflection of the cantilever noses in relation to the well top under 430 tons was 0·011 in. The permanent set was zero on removal of the test load. It was not convenient to attach extensometers at the points of maximum calculated stress; however, the Huggenberger extensometers attached to the tension steel indicated a stress of 6,180 lb. per sq. in., corresponding to a calculated stress at that point of 6,850 lb. per sq. in. Stress readings, considerably less than those calculated by usual assumptions, were recorded by the Fereday instruments, shown in Fig. 23.

XUM

A NEW MACHINE TOOL FOR LOCOMOTIVE RUNNING AND REPAIR DEPOTS

The Kitchen & Wade Universal type recently supplied to the L.M.S.R.

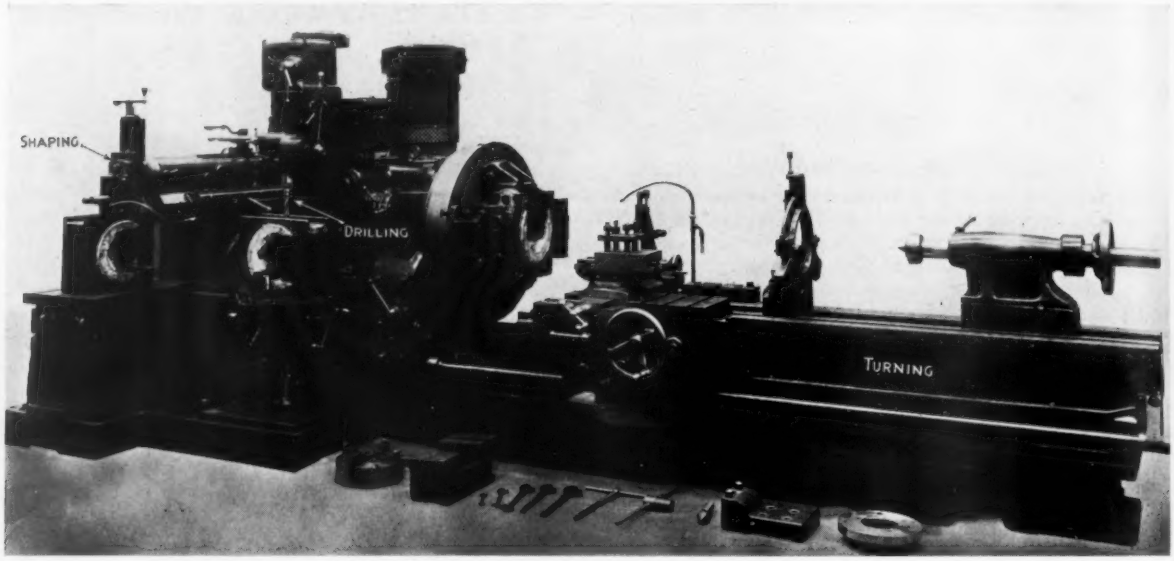
THE machine tool illustrated herewith has been specially introduced by Kitchen & Wade Limited, of Halifax, for use in locomotive running and repair depots where it is necessary to have available a complement of machines to handle expeditiously any kind of repair work, especially that requiring immediate attention. It is classified by the makers as a railway universal machine tool and in principle provides a complete plant for the class of work referred to, since it comprises on the one foundation a lathe, drilling machine, and shaping machine, together with a hacksaw attachment. The capacity is sufficient to handle the largest size of axlebox, whilst the lathe portion can accommodate work up to 8 ft. between centres. The principal claim of the makers is that this machine not only takes up less floor space but is more economical both to run and to purchase than the series of individual machines it displaces.

The drive is by a 10-h.p. motor built in to the head as shown in the illustration; this supplies power to each of the machines, which may be operated simultaneously or individually as desired. Disconnecting clutches are provided so that any one machine can be worked whilst the others are standing. The motor drive of course dispenses with all overhead motions or belting.

The lathe portion has an all-geared head with large detachable axlebox chuck. This chuck is so arranged that the special jaws can be removed quickly, and there are four dogs bolted to form an independent four-jaw chuck of large capacity. In addition, a small recess is provided, for mounting a 12-in. self-centring chuck, so that the necessity for removing the large chuck is not a pressing one. A removable half-gap piece is provided as shown in the illustration.

The lathe portion of the machine embodies all the usual features of modern practice, such as a narrow guide to the saddle, safety devices on the apron, steel trays, and pump and fittings. Other standard equipment includes sliding and stationary steadies, ball bearing centres to the loose head, and a boring bar holder for axleboxes.

The drilling machine has a capacity up to 1½-in. holes from the solid in steel, being provided with nine spindle speeds from 1,440 to 126 r.p.m. and 3 rates of power feed. The capacity of the machine is 25-in. diameter and the table has two positions for small and medium work, whilst it can be removed to allow large work to be bolted to the baseplate. The table has vertical adjustment by worm gear and the spindle has 6-in. feed, with star handle and lever feed for small hole drilling.



Kitchen & Wade Universal machine incorporating a lathe, drilling and shaping machines and a hacksaw, for use in locomotive running and repair depots

The shaper is an up-to-date and powerful tool with 22-in. maximum stroke. It is coupled to the main drive by a large friction clutch with a brake for immediate stopping. The ram has nine speeds ranging from 93 to 8 cycles per min. and four rates of feed. It admits 17 in. maximum between tool and table and the working area of the table is 26 in. by 20 in. An improved steady bracket is fitted at the outer end. The driving gearbox runs in oil, and the standard equipment includes a swivel base machine vice. A handy hacksaw attachment is provided to bolt to the face of the toolbox for sawing off bars, blanks, etc.

The complete machine is mounted on a heavily ribbed baseplate, arranged with a self-contained sump for lubricant, which is distributed by a motor driven pump to the individual cutting tools. The machine illustrated was recently supplied to the London Midland & Scottish Railway.

OTTOMAN RAILWAY FROM SMYRNA TO AIDIN

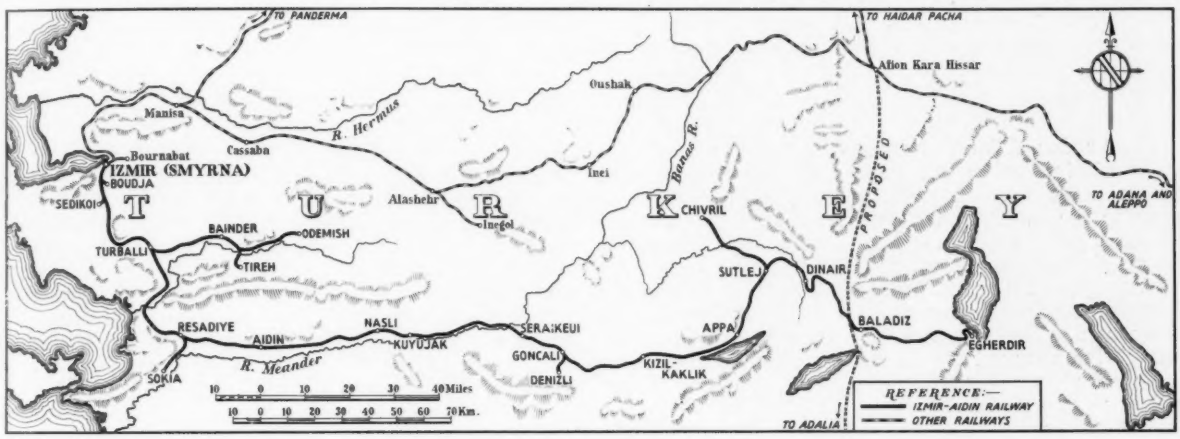
By virtue of an agreement signed between the Turkish Government and the Ottoman Railway from Smyrna to Aidin on May 1, this railway will pass into the hands of the State as soon as the agreement has been ratified by the company's stockholders and shareholders and the Grand National Assembly of Turkey, in which event the operation of the railway as from June 1 will be for the account of the Turkish Government

THE first railway from Smyrna to Aidin has now been purchased by the Turkish Government for £1,825,840, and the formal transfer, if ratified, is to take place as from Saturday next, June 1. The undertaking was established as long ago as 1856, and its first concession, dated July 11 of that year, was for a railway of some 80¾ miles from Smyrna (now Izmir) to Aidin, from which its name is derived. Work was soon put in hand by British engineers, and the line naturally took on an interest of more than ordinary significance by reason of its being the first of its kind in the Ottoman Empire. Some idea may be formed of the traffic existing in pre-railway days from the fact that during busy months more than 5,000 camels arrived daily at Smyrna. On March 23, 1858, the first trial trip took place, and on October 30 of that year the ten-mile section from Smyrna to the village of Sedikoi was opened. Lord Stratford de Redcliffe on the same day laid the foundation stone of the terminal station at Smyrna.

On September 24, 1858, constructional work was begun on the main line to Aidin, and within a few weeks some 2,500 labourers of many colours and nationalities were engaged on the earthworks. Some 27 miles were opened on December 24, 1860; 10 on September 9, 1861; and 3 (completing the first section) on November 14, 1861. The extension to Ephesus (7¼ miles), was opened on September 15, 1862, and the line opened throughout to Aidin on July 1, 1866.

Further concessions for extensions were secured in 1861, 1863, 1866, 1879, 1888, and 1906. An extension from Aidin to Kuyujak was opened for traffic in August, 1881, and from Kuyujak to Seraikeui on July 1, 1882, and a branch from the main line at Turballi, about 30 miles from Smyrna, along the valley of the Cayster, by Bainder, on to Tireh was opened on September 1, 1883. The concession of 1888, besides empowering the company to construct additional lines, accorded an extension of 25 years to 1935 of the lines then being worked and to be constructed under that concession, the Government having the right to purchase the railway in 1935 upon agreed and equitable terms.

The additional lines sanctioned under the concession of 1888 totalled 137 miles, comprising an extension from Seraikeui to Dinair, with branches to Chivril, to Denizli, and to Odemish. The Odemish branch of 18 miles was opened on December 12, 1888. Of the 90-mile Seraikeui-Dinair extension, the first section (32½ miles from Seraikeui to Kizil Kaklik) was opened on January 20, 1889, thence to Appa on July 28 of the same year; and the final section opened throughout to Dinair on October 13, 1889. The 19-mile branch to Chivril was opened on December 29, 1889. A branch line of 13¾ miles to Sokia was opened on January 26, 1891. The company purchased as from January 1, 1902, the branch line of 1½ miles from Paradise to Boudja, a residential suburb of Smyrna. This line had been worked by the company under agreement with the concessionaires since 1870. By June 30, 1907, the total length of line in operation by the company was 320 miles. Its last extension of importance was that from Dinair to Egerdir, which was not opened throughout for traffic until November 1, 1912. This brought the total length in operation to 379¼ miles on the 4 ft. 8½ in. gauge, the same as at the present day.



Map of the Izmir-Aidin railway

In consequence of non-payment of interest on some of the debenture issues in 1899, a scheme was adopted for the reconstruction of the bonded debt. Under the scheme two classes of debenture stock (4 per cent. and 5 per cent.) were created, with a restriction of the dividend on the ordinary shares to 4 per cent. until the reserve had reached £100,000. Early in the 20th century the company entered on a period of unbroken prosperity until Turkey came into the war. For each of the years 1901 to 1904 inclusive the dividend on the ordinary shares was 4 per cent. The dividend for 1909 was 4½ per cent.; for 1905, 1908, 1910, and 1911, respectively, 5 per cent. was paid; for 1912, 5½ per cent.; and for 1906, 1907, and 1913, the respective distributions were 6 per cent. Since 1913 no dividend has

been paid either on the ordinary or the preference shares, with the exception of 2 per cent. on the preference in 1929.

The railway was seized by the Turkish forces in November, 1914, and restored to the company in February, 1919, but 186 miles were actually held by Turkish Nationalists until November 6, 1922. The position was further complicated by the Greek occupation of Smyrna and the advance of the Greek forces into the interior of Asia Minor, and further by the rising of the Turkish Nationalists in the interior, who seized in March, 1920, the country covered by two-thirds of the company's line, and after the Greek retreat seized the whole railway in October, 1922. It was, however, wholly restored to the company's management on November 6, 1922. Until that date the railway had been subject to continual interference since November, 1914.

A claim against the Greek Government for an unpaid balance of transport accounts and for damage to the company's property during the Greek occupation resulted in an award dated December 19, 1931, to the company of £T.206,850; under the terms of the Treaty of Lausanne this sum is payable by means of annuities spread over a period of 40 years, together with interest at 5 per cent. per annum. In the balance sheet in the latest report there is an entry "To suspense account (Greek Government) £36,743." A net sum of £5,488 on account of this award has been credited to net revenue for the second half of 1934.

In June, 1915, holders of the 4 per cent. and 5 per cent. debenture stocks agreed that all payments of interest on their stocks should be deferred until 12 months after the signing of peace between the British and Turkish Governments, and in 1920 the interest certificates for deferred payments were converted into stock. By 1924 the arrears of debenture interest amounted to £1,250,000, but in that year it was agreed that these arrears should be cancelled in consideration of the rates of interest being raised to 5 per cent. and 6 per cent. respectively. Of the interest on the 6 per cent. debenture stock, 4 per cent. is cumulative, and 2 per cent. is subject to profits. Arrears of dividend on the 6 per cent. cumulative preference shares have been cancelled, and these shares are now 9 per cent. non-cumulative.

Receipts for the whole year 1934 were £372,768, and expenses £243,884, leaving a balance of £128,884, being an increase of £67,430 in net revenue in comparison with 1933. The share capital issued is £994,340 in ordinary shares of £20 each, and £300,000 in 9 per cent. preference shares of £20 each. Debenture stocks existing at December 31, 1934, amounted to £3,898,535.

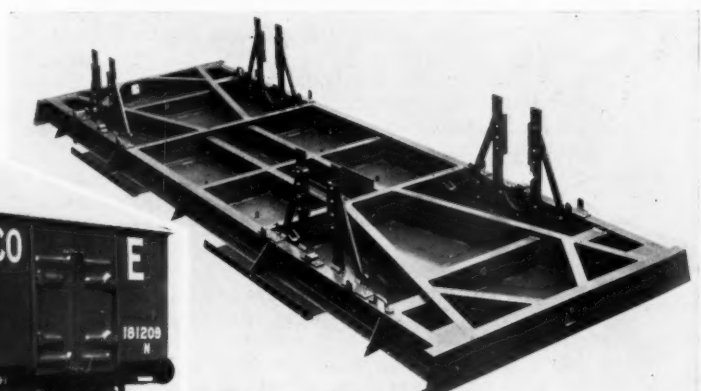
WELDED COAL WAGONS FOR THE L.N.E.R.

The London & North Eastern Railway is putting into traffic 100 locomotive coal wagons which have been built by the Metropolitan-Cammell Carriage & Wagon Company to the requirements of Mr. H. N. Gresley, Chief Mechanical Engineer, L.N.E.R. The underframes are to the standard Railway Clearing House dimensions, and the running gear, buffing, and drawgear also conform to the Railway Clearing House standard, indiarubber springs being used. The overall height is somewhat less than that of the standard 20-ton mineral wagon to permit of the wagon passing colliery screens and coaling stages where clearance is restricted. Two pairs of vertically hinged doors are provided on each side.

In general design the wagons are similar to the standard mineral wagons recently built by the Metropolitan-Cammell Carriage & Wagon Company. The underframes are of acid open-hearth steel and the body sides, ends and floors are of copper-bearing steel. The use of welding has enabled the tare weight to be considerably reduced, the tare of the welded wagon being 7 t. 19 cwt. 1 qr., compared with 8 t. 17 cwt. of a wagon with wood body. The capacity has also been increased from 767 cu. ft. to 820 cu. ft. Further advantages have been obtained in consequence of the welded construction. As the floor plates are welded to the underframe members, the strength of the underframe structure has been considerably increased.

The joints between the floor plates are also welded and water is thus prevented from passing through the floor of the wagon to the underframe members, and causing corrosion. Suitably spaced drainage holes are provided in the floor clear of the underframe members.

New welded steel 20-ton wagons for the L.N.E.R.



Above: The welded underframe (inverted)
Left: The completed wagon

RAILWAY NEWS SECTION

PERSONAL

Mr. Robin Stuart, who, as announced in THE RAILWAY GAZETTE of May 17, has been appointed Administrative General Manager of the Buenos Ayres Great Southern and Buenos Ayres Western Railways jointly, under the new scheme of co-ordination of services and management, began his railway career in 1897, with the Argentine Great Western Railway. After experience in traffic and station working, he became Stationmaster at Mendoza, the headquarters of the system in 1903, and, later in the same year, joined the Central Argentine Railway Traffic Department, where he gained further experience as Sectional Chief Clerk and Traffic Inspector. Three years later Mr. Stuart entered the service of the Entre Rios Railways, and there rose to be Commercial Agent in Buenos Aires (1908), Acting Traffic Superintendent (1909), Assistant to the General Manager (1910), and Assistant General Manager (1911). In 1912 he took over, additionally, the duties of Traffic Manager. Some two years later Mr. Stuart became Traffic Superintendent of the Cordoba Railway, and in 1919 was appointed Assistant General Manager of the B.A.G.S.R. In January, 1928, he joined the B.A. Western Railway as General Manager, prior to becoming General Manager of the B.A.G.S.R. in July, 1930, the position he has held until his new appointment now.

Mr. R. Stuart,

Appointed Administrative General Manager, B.A.G.S. and B.A. Western Railways

Mr. C. A. Roberts,

Appointed Technical General Manager, B.A.G.S. and B.A. Western Railways

Mr. C. A. Roberts, who, as also announced in the same connection in our issue of May 17, has been appointed Technical General Manager of the B.A.G.S. and B.A.W. Railways, was born in Australia in 1880, educated at Victoria College, Jersey, and later at Glasgow Technical College and the Ballarat School of Mines. He served an apprenticeship with the Fairfield Shipbuilding & Engineering Co. Ltd., Govan, and in 1900 returned to Australia, where for three years he was employed with the Phœnix Foundry at Ballarat on the construction of locomotives for the Victorian Government Railways. In 1903 he returned to England, and was engaged on the electrification of underground railways in London. After three years in England, Mr. Roberts went to Argentina as Assistant Works Manager with the B.A. Western Railway at Liniers, and in 1907 was transferred to the Locomotive Running Department, to become, two years later, chief at Mecha, the most important running section of the railway. In 1914, Mr. Roberts proceeded to England to join the Army, and served with the R.F.A. in France, Belgium and Egypt, and was wounded. He was later transferred to the Ministry of Munitions, and at the end of the war occupied the position of First Assistant Superintendent of the Royal Gun and Carriage Factories, Woolwich. On his return to the B.A.W.R. in 1919, Mr. Roberts was chiefly employed on labour questions, and represented that company on the Rules and Regulations Board. In 1922 he was appointed to take charge of the new Sub-Department of Transport, in 1926 became Sub-Traffic Superintendent, and in the following year was appointed Traffic and Transport Manager. It was on July 1, 1930, that Mr. Roberts was

appointed General Manager of the B.A. Western Railway, the post he now relinquishes under the reorganisation.

Mr. L. W. J. Hancock, Publicity Manager of Armstrong-Saurer Commercial Vehicles Limited, London and Newcastle, since its inception in 1931, is relinquishing this position in June.

Mr. W. A. Sycamore, who has been associated with the sales staff of Davey, Paxman & Co. (Colchester) Ltd., since 1932, has been appointed Manager of its marine sales.

Mr. J. M. Watson, late Manager of Ruston Lister Marine Co. Ltd., has now joined the staff of Davey, Paxman & Co. (Colchester) Ltd., as Manager of the sales of the Paxman-Ricardo high speed diesel engines.

Mr. Ashton Davies, O.B.E., Chief Commercial Manager, L.M.S.R., and Mr. Percy Syder, London City Goods Manager, L.N.E.R., have been elected Members of Council of the London Chamber of Commerce.

Indian Railway Staff Changes

Mr. J. M. D. Wrench, Chief Controller of Standardisation, Railway Board, has been granted 6½ months' leave, as from April 1, and is now in England.

Mr. B. G. Smith, Divisional Superintendent, E.I.R., has been granted three months' leave, as from May 30.

Mr. A. Cornish has been appointed to officiate as Deputy Chief Mechanical Engineer, N.W.R., as from March 23.

Mr. H. M. Baikie has been appointed to officiate as Deputy Agent (Works), E.B.R., as from April 11.

Mr. A. E. Tylden Pattenson, who, as announced in The Railway Gazette of January 11, was appointed to officiate as a Member of the Railway Board, has now been confirmed in that appointment.

Mr. C. F. Gilbert has been appointed to officiate as Deputy Agent, E.I.R.

Lt.-Col. R. E. Gordon, M.C., R.E., has been appointed to officiate as Divisional Superintendent, N.W.R., as from March 21.

Khan Bahadur Mazaffar Hussain has been appointed to officiate as Deputy Chief Engineer, N.W.R., as from February 28.

London and Home Counties Transport Golfing Society

The first meeting of this new society was recently held on the Crews Hill golf course. After a series of enjoyable games had been played, it was the unanimous decision of the participants that the career of the new society had had a most auspicious beginning and that it promised to form a happy common meeting ground for all those—operators and manufacturers alike—whose interests are in the transport industry. At a meeting held after the matches, it was agreed to ask Mr. R. H. Pitts, Chief Stores Superintendent, London Transport, to become the society's first President and it is hoped that Mr. H. Kingsbury, a Director of the British Electrical Federation Limited, will become one of the two Vice-Presidents.

The next meeting of the society has been fixed for Wednesday, June 19, at Woodcote Park, Epsom, and an invitation is extended to anyone associated with the transport industry to be present on that occasion. Mr. H. J. Ferguson, Editor of our contemporary, *The Electric Railway, Bus and Tram Journal*, has consented to act as Honorary Secretary, and it would be helpful if all who propose to be present at Woodcote Park on June 19 would intimate to him at Avenue Chambers, Vernon Place, Southampton Row, W.C.1, their intention to do so.

L.M.S.R Quota Scheme Presentations

On Wednesday the first annual distribution of the L.M.S.R. Commercial Department Quota League shields and cups took place in the Shareholders' Room, Euston station. Mr. Ashton Davies, Chief Commercial Manager, presided and was supported by the following directors and officers:—

Messrs. E. B. Fielden, G. A. T. Taylor, G. H. Loftus Allen, T. E. Argile, A. F. Bound, C. R. Byrom, W. H. C. Clay, G. L. Darbyshire, A. Eddy, Sir Harold Hartley, Messrs. E. J. H. Lemon, T. A. Moffett, H. W. Phillips, T. W. Royle, J. Shearman, W. A. Stanier, and S. J. Symes.

The proceedings were opened by Mr. Ashton Davies, who gave a brief survey of the success of the Quota scheme during 1934. Mr. Lemon then presented the shields to the 157 stationmasters or agents representing the winning stations, after which Mr. E. B. Fielden, Deputy Chairman, L.M.S.R., presented the directors' inter-district championship cups to the managers of the winning districts. Chester headed the passenger league, and Wolverhampton was announced top of the goods league. Brief speeches were then made by the district managers on behalf of the cup winners, and by the stationmaster for Calveley and the goods agent for Deepfields on behalf of the shield winners heading the passenger and goods line leagues No. 1. Finally votes of thanks to Mr. Lemon and Mr. Fielden were proposed and seconded respectively by Messrs. H. W. Phillips and T. A. Moffet, and to Mr. Ashton Davies by Mr. C. R. Byrom, to which suitable replies were made. Shots were taken during the proceedings for inclusion in the film, "Outstanding Events of 1935."

Visit of the Institute of Transport party to Austria: Group taken outside the Town Hall, Vienna

In the centre of the front row are Dr. Asperger, Chief Magistrate of Vienna, and Mr. Sidney E. Garcke, President of the Institute

The Institute of Transport Visit to Austria

In last week's issue some account was given of the visit to Austria of the Institute of Transport party up to the third day at Innsbruck. The morning of that day (Tuesday, May 21) was devoted to an inspection of the Innsbruck running shed of the Austrian Federal Railways, to which the party was conveyed by the special train, which has been placed at its disposal by the railways administration. The visitors were received and conducted over the shed by Herr Karner (Chief Mechanical Engineer), Herr Grundner (Divisional Locomotive Superintendent), and Herr Merl (Works Manager, Innsbruck). This shed is concerned with the maintenance of the electric locomotives used for hauling international express trains between Salzburg and Buchs, of carriage and wagon stock, and of petrol-driven vehicles (inspection cars, &c.). The number of locomotives allocated to the shed is 72 and the staff employed totals 696. The inspection included the erecting, repair, turning, joinery, welding, and paint shops.

After lunch on the same day the party left Innsbruck for Salzburg, and travelled through country of great beauty. The journey was accomplished in a little more than four hours, and the arrival at Salzburg was greeted with music played by the railwaymen's band, which was drawn up on the platform. In the evening there was a reception in honour of the visitors at the *Residenz* (the old palace of the Archbishops of Salzburg), which was given by the Governor of Salzburg (Dr. F. Rehrl) and the Burgomaster of Salzburg (Herr H. Ott), both of whom addressed to the party a cordial welcome, which Mr. Sidney E. Garcke, President of the Institute, gracefully acknowledged.

May 22 was taken up with a tour of the town of Salzburg and a visit to the Salzkammergut lakes, during which a call was made at the famous "White Horse Inn" for tea. On the following day an early start was made in motor coaches for a visit to the Glocknerstrasse, the new mountain road through the Alps to connect Germany and Italy, which is now nearing completion. The motor coaches climbed steadily to Hochmais at a height of 6,200 ft., the journey affording splendid views of the surrounding mountains. The huge snow banks which were in evidence towards the end of the climb were sufficient evidence of the difficulties which have to be contended with in keeping this road open. From Hochmais the party descended to Zell am See, where it joined the special train sent by the Federal Railways for the return to Salzburg.

The stay in Salzburg came to an end on May 24, when the party proceeded to Linz, an important industrial town of Upper Austria with a population of about 100,000. On the platform was Herr O. Dammer, the Chief Magistrate of the town, to extend a welcome to the visitors. Lunch was taken in the sylvan atmosphere of the Volksgartensäle, where the railway students' band added to the enjoyment of everyone by rendering selections with worthy skill. The Burgomaster of Linz, Dr. W. Bock, was present at lunch and proposed the toast of the visitors in a short speech. The President replied briefly. After lunch the railway works and the running shed located at Linz were inspected under the guidance of the following officers of the Austrian Federal Railways: Herr Karner (Chief Mechanical Engineer), Dr. Nussbeaum (Deputy Chief Mechanical Engineer), Herr Koerber (General Workshops Superintendent), Herr Reining (Works Manager at Linz), and Herr Wicher (District Locomotive Superintendent).

The Linz railway works covering an area of 266,708 sq. yd. and employing staff of 1,082, were opened originally in 1860 and have since been enlarged and re-organised from time to time. They are responsible for the maintenance and repair of steam locomotives, boilers, tenders, passenger coaches, and goods wagons, and for the overhauls and maintenance of electric locomotives. In addition all screw couplings are repaired (about 4,000 each month) at the Linz works. The Linz running shed is one of the largest depots of the Austrian Federal Railways and, with a staff of 796 including drivers and firemen, deals with 122 steam locomotives. The various sheds and arrangements were inspected, particular interest being taken in the system of boiler washing with hot water at high pressure obtained from the injector of an adjacent locomotive.

During the visits to the works and running shed, the ladies were taken on a sight seeing tour of the town and its environs in motor coaches kindly provided by the Burgomaster and the local authority. They were thus given the opportunity of visiting, *inter alia*, the Poestlingberg and the monastery of St. Florian.

The departure from Linz was made at 5.22 p.m., and the 186 km. journey to Vienna was completed in just over 2½ hours. A generous welcome was given to the party at Vienna. The National Anthem was played by the railway band as the train drew up, and on the platform to greet the party were Herr Nouackh (Chief Operating Manager, A.F.R.), Herr Kankorsky (Secretary, A.F.R.), Herr Jary (Divisional Manager at Vienna, A.F.R.), and Herr Winter (Deputy General Manager, Vienna Tramways).

On May 25 there was a morning sight-seeing tour of the principal places of interest in Vienna, at the conclusion of which the visitors were conveyed to the Town Hall. Here they were addressed by Dr. Asperger, the Chief Magistrate of the City, who was deputising for Dr. Schmitz, the Burgomaster who, it was learned with regret, was indisposed. Dr. Asperger, speaking in English, warmly welcomed the Institute party to Vienna, and went on to refer to matters of transport interest connected with the City; from time immemorial it had been a cross-point of the principal European ways of communication and, consequently, a centre of international transport and traffic. He hoped that the members of the Institute would find the City's municipal tramways and its metropolitan railway to be of a high standard, and its road-development schemes of interest. In conclusion, Dr. Asperger referred, in moving terms to the commemoration of the Silver Jubilee of "the venerable ruler of your glorious fatherland" and to the friendship and sympathy between Austria and England.

A visit to the Semmering, the famous beauty spot and pleasure resort, was made on May 26. The Austrian Federal Railways generously provided for the journey, three railcars, one diesel-electric, one petrol-hydraulic, and one steam. The cars stopped at Glocnitz so that members might change cars and compare the running, comfort, &c. The journey was one more example of the great engineering skill which had made possible the routes of the Austrian Federal Railways, and of the wonderful natural beauty of the country. The Semmering line was opened to traffic in 1854 and was the first Alpine railway. It has an average gradient of 1:40 and curves of a radius of only 180 metres. On arrival at the Semmering station the party proceeded by motor to the luxurious Sudbahn Hotel. Ing. Anton Schoepfer, General Manager of the Austrian Federal Railways, presided over the gathering, at which there were also present Herr R. E. Kaan and Dr. Nussbeaum, the Chief Electrical Engineer and the Deputy Chief Mechanical Engineer respectively of the Federal Railways.

Ing. Schoepfer tendered a cordial welcome to the members of the Institute who had come "from the country of Stephenson" and spoke of Austria's efforts, in the development of its railway system, to overcome great natural difficulties and, after the war when it was left with only one sixth of its pre-war system, to adapt its rail system to the most modern requirements. He concluded by proposing the toast of the transport relations between Great Britain and Austria. Mr. Garcke, on behalf of the Institute, acknowledged Ing. Schoepfer's gracious welcome and also expressed thanks for the hospitality and the wonderful organisation which had been associated with the progress of the tour. The return to Vienna was made in the early evening.

The programme of the tour has also included visits to the works and depots of the Vienna Municipal Tramways, the Vienna Harbour, and the Mallnitz Power Station at Obervellach.

XUM

Accelerated American Train Services

(*See editorial article on page* 1057)

Not for many years past has there been witnessed such a competition in railway travelling facilities as that which is now proceeding between three American railroads for the traffic between Chicago, Milwaukee, and the Twin Cities of St. Paul and Minneapolis. If the existence of a fourth competitor, between Chicago and Milwaukee, be taken into account, then steam, the internal combustion engine, and electricity are all concerned. The genesis of the competition may be ascribed to the building by the Chicago, Burlington & Quincy RR. of the first Burlington Zephyr high-speed train, foreshadowing the later introduction of such units on that company's route from Chicago to the Twin Cities. But before the necessary equipment could be built, based on the experience so gained, the other two competitors determined to try what could be achieved with steam. First of all, the Chicago, Milwaukee, St. Paul & Pacific with a standard 4-6-4 express locomotive, made on July 20, 1934, an experimental run from Chicago to Milwaukee, in which the 85·0 miles were covered in 67 min. 35 sec., 68·9 miles intermediately being reeled off at an average of 89·9 m.p.h. It had already been decided to cut the best Chicago-Milwaukee times to 90 min., and this allowance was subsequently curtailed to 85 min., but acceleration over the whole Chicago-Minneapolis route was deferred until locomotives could be built suitable for covering the whole 431-mile route at a 60 m.p.h. average throughout.

Chicago & North-Western

Meantime the Chicago & North Western stepped in, and on January 2, 1935, inaugurated a new service, known as The 400, owing to its being timed over 400 miles of its course at an average speed of a mile-a-minute. From its introduction this express was booked to cover the 85 miles from Chicago to Milwaukee in 80 min., and to reach St. Paul in 7 hr., and Minneapolis in 7½ hr. The success of the innovation was immediate. In the first three months 28,000 passengers were carried, with a daily average of 160, and rising to 10,000 in the third month. During these months, also, a severe test was imposed on the operation by heavy snow and below zero temperatures, notwithstanding which consistent punctuality was maintained. As a result it has been necessary to increase the original four-car formation by two additional parlour cars; all the stock is of standard pattern, modernised internally and air-conditioned, and the only divergence from standard practice is found in the locomotives. Four Pacifics of the E.2 class have been rebuilt as the E.2A class, with Nicholson thermic syphons, working pressure raised from 210 to 225 lb. per sq. in., improved front ends, and a tractive effort of 45,800 lb., oil-firing, and a special type of disc driving wheels, 6 ft. 7 in. in diameter in place of 6 ft. 3 in. previously, drilled with large holes for lightness, which are expected to improve the balance of the engines at high speeds. In order to increase the capacity of the tenders, and save replenishment, a new 6 ft. section has been inserted in the previous tenders, increasing the water capacity from 8,275 gals. to 15,000 gals., and providing for 5,000 gals. of fuel oil. It has now been found possible to timetable a further acceleration of this service by cutting 30 min. from the schedule. The time for the 85 miles between Chicago and Milwaukee has been reduced to 75 min., raising the start-to-stop average speed to 68·0 m.p.h., and over the 408·6 miles between Chicago and St. Paul it has come down to 390 min., stops included. The new departure time from Chicago is 3.30 p.m., and, in the southbound direction, 3 p.m. from Minneapolis and 3.30 p.m. from St. Paul. Engines and crews are changed at Milwaukee in both directions, and the northbound and southbound "400's" are arranged to meet at Adams, which is approached by 50 miles of single track in both directions—a detail calling for the strictest punctuality of operation. Between Milwaukee and Adams the 124·5 miles are run both ways in 120 min. The only other stop is Eau Claire.

Chicago, Milwaukee, St. Paul & Pacific

The reply of the Chicago, Milwaukee, St. Paul & Pacific has just been made. It is a new service called The Hiawatha—the "fleet of foot" of Longfellow's poem. For the service two entirely new trains have been built, with both locomotives and coaches streamlined. The oil-fired 4-4-2 locomotives embody many features new to American locomotive practice, and were the subject of a special illustrated article on p. 1037 last week. The coaches are of a new all-welded type which is later to be introduced on this railway on an extensive scale. They are one-third lighter than standard C.M.St.P. & P. stock, of luxurious equipment, and, of course, air-conditioned. Each train consists of a café car with kitchen, dining-room seating 24, café section seating 24, and cocktail bar; three coaches, each with 48 passenger seats and men's and women's lounges providing 15 more seats; and two parlour cars, seating 22 and 24 respectively, and both provided with men's and women's lounges with 15 additional seats. This gives a total seating capacity, excluding the café car, of 265. The rear car has a "beaver-tail" end for streamlining effect. The Hiawatha, which went into service on May 29 leaves Chicago at 1 p.m., and, like The 400, makes the 85-mile run to Milwaukee in 75 min. Stopping subsequently at Portage, New Lisbon, La Crosse, and Winona, it reaches St. Paul (409·9 miles by this route) at 7.30 p.m., and Minneapolis at 8 p.m. The return journey begins at 12.30 p.m. from Minneapolis, and 1 p.m. from St. Paul; Milwaukee is left at 6.15 p.m., and Chicago reached at 7.30 p.m. The maximum working speed is fixed at 90 m.p.h., though it is calculated that the new locomotives are capable of considerably higher speeds than this. In addition to this flyer, the current timetables of the C.M.St.P. & P. show two trains covering the 85 miles between Chicago and Milwaukee in 80 min., three in 85 min., and three (including an intermediate stop) in 90 min.

Chicago, Burlington & Quincy

Meanwhile the two Zephyr diesel-operated units specially built by the Chicago, Burlington & Quincy entered on their regular running on April 21. The C.B. & Q. follows a route more to the westward than the C.M.St.P. & P. and C. & N.W. through Dubuque instead of Milwaukee, and has the disadvantage in the matter of distance, with a journey of 431 miles between Chicago and St. Paul. But the same 6½ hr. schedule is being worked to, involving an average speed of 66·3 m.p.h. throughout, inclusive of intermediate stops at Aurora, Savanna, East Dubuque, and North La Crosse, and an additional stop at Miner on the eastbound journey. The fastest booking is over the 116 miles from North La Crosse to East Dubuque on the eastbound journey, allowed 95 min., which works out at 73·3 m.p.h., and so far as present information goes, is the fastest booked run on the American continent. On a preliminary experimental run, made on April 6, one of these trains completed the journey in 5 hr. 33 min., at an average speed of 77·7 m.p.h., and it is claimed that a maximum speed of 104 m.p.h. was attained. Up to June 1 the new Zephyrs made one trip each way daily, but so great has been the demand for accommodation that from June 2 each unit is to make the double journey each way, leaving the respective terminals at 8 a.m. and 4 p.m. This allows only an hour for turnround, and involves a total daily mileage of 882 miles each unit. Maximum speeds up to 90 m.p.h. are allowed for in the schedule. Each train consists of three cars, and seats 88 passengers; a kitchen and pantry are provided, and passengers can be served either in a "dinette," or dining section of the middle car, seating 16 persons, or at a lunch counter with four pedestal seats. Ample luggage space is also arranged in the front car, behind the engine-room. The result of this competition is to provide three daily services in each direction, at well-spaced times, between Chicago and

the Twin Cities, completing the Chicago-St. Paul journey in 6½ hr. in each case, whereas before this competition the best ordinary time was about 10 hr.

Missouri Pacific

Elsewhere in the U.S.A. the diesel-operated high-speed units are not being allowed to have it all their own way. Recently the original Burlington Zephyr, now in regular service between Omaha and Kansas City—a difficult route with various restrictions on speed—has had its time cut from 4 hr. to 3 hr. 55 min. for the 196 miles. This the competing Missouri Pacific RR. has countered by accelerating trains Nos. 105 and 106, now appropriately christened The Marathon, to a run of 3 hr. 59 min. over its 199-mile route between the same points. The previous times were 5 hr. 25 min. from Omaha to Kansas City, and 5 hr. 5 min. in the reverse direction, so that the acceleration has been very considerable. Through coaches are run between Lincoln, Nebraska, and Kansas City, connecting at Union with the Marathon, and so competing with the Zephyr, which starts its daily journey at Lincoln, running thence to Omaha before leaving for Kansas City. Competition here is thus extremely keen.

New York and Chicago

Two other competitive railway routes on which some striking accelerations of service have been seen since the end of April are the New York Central Lines and the Pennsylvania Railroad. As previously mentioned in THE RAILWAY GAZETTE, the famous Twentieth Century Limited and Broadway Limited expresses have been quickened to the unprecedented time of 17 hr. in both directions between New York and Chicago, the former involving an inclusive average speed of 56·4 m.p.h. over a 958·7-mile route, and the latter an average of 53·0 m.p.h. over one 901·7 miles in length, but attaining a maximum altitude of 2,193 ft. in the Allegheny Mountains. On the Pennsylvania run the scheduled average speed between Englewood (Chicago) at Fort Wayne is 64·5 m.p.h. (140·9 miles in 131 min.). The Twentieth Century Limited must average 59·7 m.p.h. for 424·7 miles of its westbound run from Buffalo to Elkhart, and 62·1 m.p.h. for 226·9 miles of its eastbound journey, from Englewood to Toledo. The supplementary service charge for the use of the Twentieth Century and Broadway Limited expresses has been reduced from $10 to $7·50. Many other of the New York-Chicago expresses are also expedited; the eastbound Commodore Vanderbilt of the N.Y.C. is now accelerated to a time of 18 hr. 20 min. and the eastbound Liberty Limited of the Pennsylvania to the same figure—both 100 min. less than the time which was for so many years the exclusive characteristic of the famous Broadway and Century fliers. Indeed, so extensive has been the speeding-up over these routes that, apart from the Broadway and the Century, eleven New York Central and eight Pennsylvania trains now make the New York-Chicago run in less than 20 hr., and the average journey time of no fewer than thirty daily trains on the service, fifteen on each route, works out at 19¼ hr. only. For the fifteen New York Central trains the overall average speed is precisely 50 m.p.h., and for the fifteen Pennsylvania trains 46·8 m.p.h. No other railways in the world can show so fast and frequent a service over a route nearly a thousand miles in length. Some extremely fast runs have been introduced, particularly on the Pennsylvania, one of whose trains (the Union) is booked to cover the 64·2 miles from Fort Wayne to Plymouth in 54 min., at a start-to-stop speed of 71·3 m.p.h.—practically equal to that of the Cheltenham Flyer.

As regards other services, St. Louis is brought within 21 hr. of New York by the accelerated St. Louisan, of the Pennsylvania, giving the average speed of 50·1 m.p.h. over this route of 1,051·7 miles. The best New York Central time between these points is 22½ hr., but the distance in the latter case is 1,156·9 miles, giving an overall speed of 51·4 m.p.h. The Baltimore & Ohio is, on June 1, to put a 5½ hr. service into operation between Chicago and St. Louis, 284 miles, with its new streamlined steam train, the Abraham Lincoln. We have already given illustrated descriptions of the two special steam locomotives built for this service (see THE RAILWAY GAZETTE for February 1 and April 19 last). In reply to this, the Wabash is, from June 2, to expedite its Banner Blue Limited between the same points (286 miles) to a similar 5½ hr. schedule, and already the Illinois Central has announced a 5½-hr. booking by its route when the new diesel-electrics are ready.

New York and Washington

Over the electrified sections of the Pennsylvania speeds are now rising, as witness the fact that 32 trains daily now cover the 75·7 miles between Newark and North Philadelphia in from 71 to 76 min., including The Congressional, which covers the 224·8 miles between New York and Washington in 235 min., including stops at Manhattan Transfer, North Philadelphia, Wilmington, and Baltimore. In competition with this service, the Baltimore & Ohio RR. has accelerated its fastest trains between New York and Washington to the level 4 hr.—5 min. only in excess of the P.RR. time—over its 223·6-mile route. In New England the diesel-operated Flying Yankee of the Boston & Maine RR. is running the 111·3 miles between Boston and Portland in 110 min., and continuing over the Maine Central to Bangor, a further 135·4 miles in 3 hr.

New England

Early in June the diesel-operated Comet of the New York, New Haven & Hartford RR. will be put into service, and is intended to work a Shuttle express service between Boston and Providence, covering the 43·3 miles, with one intermediate stop, in 44 min., and making five runs daily. This is a three-car articulated set with engines at each end, seating 160 passengers, and not provided with luggage space or restaurant car accommodation; the running of one set of engines alone provides for a speed of 68 m.p.h.; with both sets in use a cruising speed of 90 m.p.h. is allowed for, and a possible maximum of 110 m.p.h. An acceleration to 55 m.p.h. is obtained in 2 min. from the start. The new 44-min. schedule between Boston and Providence compares with from 55 to 75 min. by existing trains. In an experimental run on April 29, The Comet covered the 156·8 miles from New Haven to Boston in 143 min., or 55 min. less than the best existing steam train (the Yankee Clipper), at an average of 65·8 m.p.h., and reached a maximum of 110½ m.p.h. The 43·3 miles between Providence and Boston were run in 32 min. 21 sec., at an average speed of 80·3 m.p.h. A notable feature of these radical accelerations in America is that a total of over 10,000 miles daily is now booked to be covered by railways of the United States at speeds of over sixty miles an hour from start-to-stop.

Exports of Railway Material from the U.K. in April

	Apl., 1935	Apl., 1934	Four Months Ending Apl., 1935	Four Months Ending Apl., 1934
	£	£	£	£
Locomotives, rail	13,977	21,837	241,337	108,192
Carriages and wagons	131,760	71,391	378,017	232,531
Rails, steel	43,725	15,550	233,187	134,010
Wheels, sleepers, fishplates and miscellaneous materials	158,247	61,586	449,699	236,271

Locomotive and rail exports included the following :—

	Locomotives		Rails	
	Apl., 1935	Apl., 1934	Apl., 1935	Apl., 1934
	£	£	£	£
Argentina	—	—	5,802	6,216
Union of South Africa	—	—	32,436	15,915
British India	6,671	—	30,392	9,746

XUM

Internal Air Services

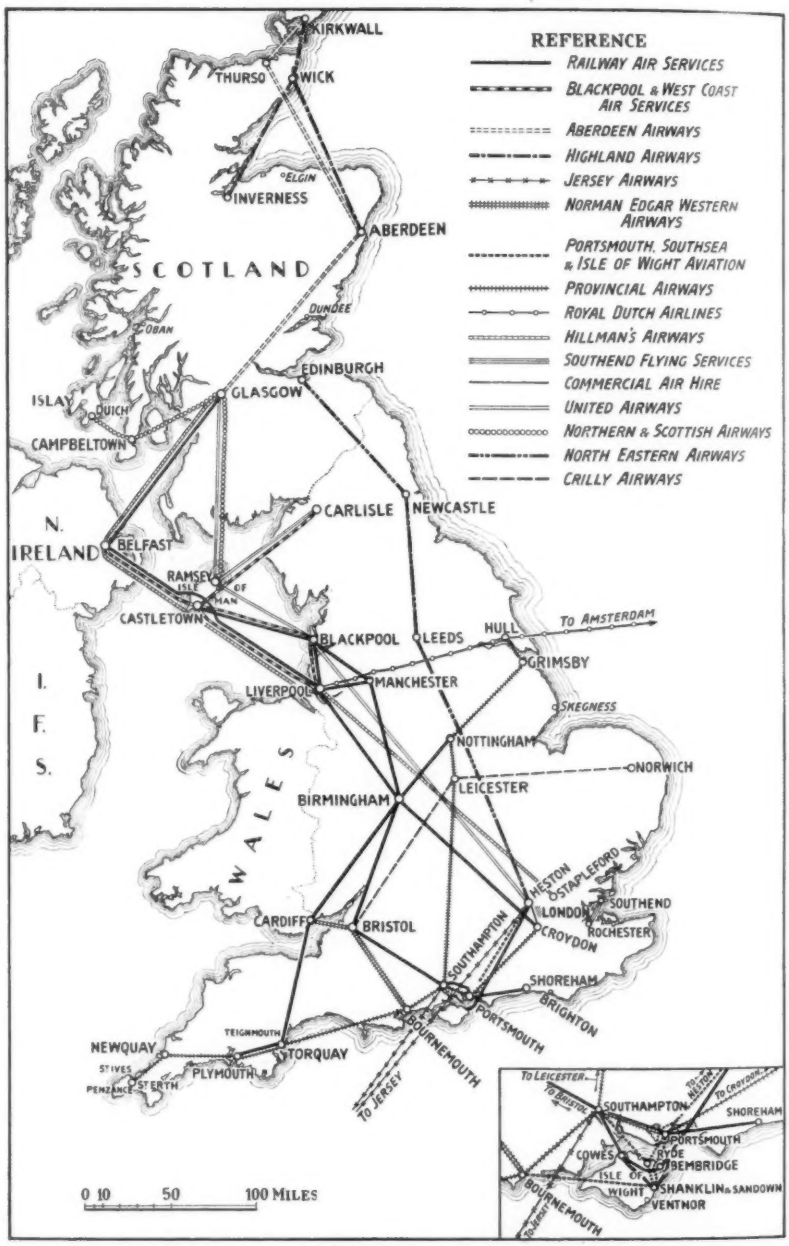
Since we last published in our issue of October 12, 1934, our half-yearly review of the internal air services of Great Britain, considerable developments have taken place. Chief among these are those made by Railway Air Services Limited, the summer timetable of which came into force on May 27, and entails the flying of more than 6,000 miles every week-day, covering some 42 services. The routes over which the Railway Air Services will operate this summer are as follow:—

Service	Number of Week-day Services in Both Directions
Nottingham – Birmingham (Castle Bromwich)–Cardiff (Municipal airport)–Denbury (for Newton Abbot, Teignmouth and Torquay) –Plymouth (Municipal airport, Roborough)	4
Liverpool (Municipal aerodrome, Speke)–Birmingham (Castle Bromwich)–Bristol (Municipal airport, Whitchurch)–Southampton(Municipal airport)–Portsmouth (Municipal airport)–Brighton, Hove and Worthing (Municipal airport, Shoreham)	4
London (Croydon) – Birmingham (Castle Bromwich) – Manchester (Barton)–Liverpool (Speke)–Belfast (Aldergrove)–Glasgow (Renfrew) and Manchester (Barton)–Blackpool (Squire's Gate)–Ronaldsway (Isle of Man)	2
The Manx Airway: Manchester (Barton)–Liverpool (Speke)–Blackpool (Squire's Gate)–Ronaldsway (Isle of Man)	8
London (Heston)–Bembridge Aerodrome–Cowes (Somerton aerodrome), Isle of Wight	6
London (Heston)–Sandown and Shanklin (Lea aerodrome), Isle of Wight	6 (10 on Saturdays)
Southampton airport–Cowes aerodrome–Sandown and Shanklin (Lea aerodrome), Isle of Wight ...	12
Total services	42

The extensions to existing Railway Air Services routes are those from Birmingham across to Nottingham, and from Southampton to Portsmouth and Shoreham for Brighton and Worthing. Entirely new services are the Southampton-Cowes-Sandown and Shanklin ferry, and the Heston-Sandown and Shanklin direct connection which operates from June 1-30 at week-ends only, but as a daily service from July 1 onwards. An alteration has been made in the London terminus of the Isle of Wight service, the planes being diverted from Croydon to Heston. The Manx Airway, as already announced in THE RAILWAY GAZETTE, is being operated in conjunction with the Isle of Man Steam Packet Company, while the London-Isle-of-Wight route is, as last summer, being run jointly with Spartan Air Lines Limited. In addition, connections will be provided on most days to Jersey from Southampton by Jersey Airways Limited, a company controlled by Channel Islands Airways Limited, in which both the Southern and Great Western Railways have holdings. Agreements as to timetable co-ordination have also again been made with Norman Edgar Western Airways. Sunday services are to be operated on certain R.A.S. routes.

Newcomers to air transport since last autumn are United Airways (London - Blackpool - Isle of Man - Carlisle / Glasgow), Northern & Scottish Airways (Glasgow-Isle of Man, and Glasgow-Campbeltown-Islay), North Eastern Airways (Edinburgh-Newcastle-Leeds-London), Crilly Airways (Norwich-Leicester-Bristol), and Commercial Air Hire (Heston-Croydon). Crilly Airways also operates an on-request service between Croydon and Doncaster. Extensions this summer by established operators other than R.A.S. include those between Hull-Grimsby-Nottingham-Leicester-Southampton (Provincial Airways); Aberdeen-Thurso-Kirkwall (Aberdeen Airways); and Isle of Man-Carlisle / Belfast, and Liverpool-Isle of Man (Blackpool & West Coast Air Services).

Various proposals are under consideration for further new routes, including a scheme promoted by Aberdeen Airways to link Aberdeen, Edinburgh, and Hull with London.



Sketch map of the internal air lines of Great Britain

London Passenger Transport Bill : Financial Estimates

Mr. Frank Pick, in giving further financial information at the request of the Committee, on May 22, produced tables showing the details of the capital expenditure on improvements to railway works included in the programme covered by the Bill. These are set out in the accompanying table, together with estimated financial results from each part of the programme, with a view to showing that they were a commercial proposition.

The first group of items, totalling up to £5,925,000, dealt with the improvement of the Baker Street and Waterloo line, to take the heavier train service and re-signalling, and it meant some addition to the terminal facilities at the Elephant and Castle to enable trains to be reversed. It included the reconstruction of Baker Street station and the provision of escalators for all purposes. It provided for the tube connections from Baker Street to Finchley Road, and for all the works on the Metropolitan line up to and including the electrification to Amersham, together with the rolling stock wanted for the working of these additional electric services. The present population living in the area served by the Metropolitan main line and branches travelled on the average about 80 times a year by railway, and he was estimating that in ten years 510,000 people would travel 85 times a year. The estimated additional expenses had been ascertained by actually working out the regular train service they would like to put upon the new system. That showed that they had to increase the car mileage on the Metropolitan Railway by 25 per cent., and on the Bakerloo line by roundly 4 per cent., making altogether on the combined system an increase only of 19 per cent. Although the increased mileage would be run chiefly on the Metropolitan Line, the new through services to the west end would necessarily be worked by tube cars. It was a little cheaper to run a tube train than the Metropolitan trains, so that the substitution of tube car mileage for the Metropolitan car mileage was some economy. The actual cost of running the additional miles worked out at 4·2 pence per car mile. The fixed charges would not go up with the additional car mileage in anything like an even ratio. Applying the 4·2 pence per car mile to the additional car miles they had to run, they got the figure of £82,500 as the cost of carrying the additional traffic. The very low average loading of the Metropolitan trains would enable them to carry 50 per cent. more passengers with only 25 per cent. increase of car mileage. In perhaps five years they would have an additional revenue of £250,000 to apply to the support of the additional capital of £5,925,000, a return of just over 4 per cent.

The alterations to the Circle, at a cost of £860,000, were not to benefit the Circle; they were to release the Circle

DETAILS OF CAPITAL EXPENDITURE ON IMPROVEMENTS TO RAILWAY WORKS INCLUDED IN THE PROGRAMME COVERED BY THE LONDON PASSENGER TRANSPORT BILL, 1935

	£	£
1.—*Metropolitan and Bakerloo Lines improvement scheme, including West End connection*		
Bakerloo Line improvements : resignalling and terminal facilities at Elephant & Castle	489,000	
Baker Street station improvements, including escalators	120,000	
Baker Street to Finchley Road : West End tube connection	1,790,000	
Finchley Road to Harrow : re-arrangement of tracks, and station works	905,000	
Harrow to Rickmansworth : four-tracking	1,026,000	
Rickmansworth to Amersham : electrification	350,000	
Uxbridge Line improvements, including new terminal station at Uxbridge	535,000	
Rolling stock	710,000	
		5,925,000
2.—*Circle Line : Works for breaking Circle service at Baker Street and South Kensington*		
Baker Street : alterations to tracks	565,000	
Cromwell curve : flying junction	240,000	
South Kensington : alterations to tracks and platforms	55,000	
		860,000
3.—*Upminster Line : Works at Aldgate East, &c., to increase capacity*		
Alterations to South curve, Aldgate East	435,000	
Aldgate East station reconstruction	415,000	
New substation at Minories	90,000	
Whitechapel station, improved interchange with East London Railway	60,000	
Rolling stock	350,000	
		1,350,000
4.—*King's Cross station*		
Reconstruction of tube stations with common ticket hall and escalators	313,000	
Reconstruction of Metropolitan station further west to connect with new tube station	210,000	
		523,000
5.—*Monument station*		
Replanning of ticket hall to connect with new public subways		48,000
Total railway works		£8,706,000

METROPOLITAN AND BAKERLOO LINES IMPROVEMENT SCHEME ; ESTIMATED FINANCIAL RESULTS

Present population of area served by Metropolitan main line and branches (1934)	360,000
Increased population expected to arise in the area	150,000
Estimated population of area (say 1944)	510,000
Existing passenger journeys per annum on the Metropolitan main line and branches	35,000,000
Additional journeys expected as a result of programme of works	17,500,000
Total passenger journeys	52,500,000
	£ per annum
Additional journeys, as above, at average fare of 5d. will yield gross additional revenue of (Existing average fare is 5·71d. per passenger)	365,000
Deduct additional expenses to earn additional receipts, based on ascertained costs in relation to estimated additional car mileage	82,500
Additional net revenue	282,500
Deduct appropriation to reserves, say	32,500
Revenue ultimately available for interest on capital	£250,000

UPMINSTER LINE IMPROVEMENTS ; ESTIMATED FINANCIAL RESULTS

Present population of area served by Upminster line, east of the Lea Valley (1934)	358,000
Increased population expected to arise in the area	80,000
Estimated population of area (say 1944)	438,000
Existing passenger journeys per annum on the Upminster line	37,000,000
Additional journeys expected as result of programme of works	7,500,000
Total passenger journeys	44,500,000
	£ per annum
Additional journeys, as above, at average fare of 4d. will yield gross additional revenue of (Existing average fare is 4·19d. per passenger)	125,000
Deduct additional expenses to earn additional receipts (30 per cent. operating ratio)	37,500
Additional net revenue	87,500
Deduct appropriation to reserves, say	10,000
Revenue ultimately available for interest on capital	£77,500

RAILWAY WORKS INCLUDED IN THE PROGRAMME ; SUMMARY OF ESTIMATED FINANCIAL RESULTS

	Capital cost	Net annual revenue to be secured
	£	£
Metropolitan and Bakerloo Lines improvement scheme	5,925,000	250,000
Circle Line : Works for breaking circle service	860,000	—
Upminster Line : Works at Aldgate East, &c.	1,350,000	77,500
King's Cross station reconstruction	523,000	21,400
Monument station improvements	48,000	—
Total	£8,706,000	£348,900

This result represents a return upon the total capital expenditure of 4 per cent.

tracks for use by the through trains on the Metropolitan line towards the east on one side of the Circle, and of the District main line towards the west on the other. Unless they could turn the Circle into a shuttle they could not take the Circle trains off between Baker Street and Aldgate in order to run through trains from the Metropolitan main line out to Upminster on the east, a service which was badly wanted both for the main line and because of the vast extension of the population at Upminster and Barking. They had undertaken with the Kensington Council that if the Circle were broken, Kensington would have this convenient shuttle for exchange, and in order to implement the promise they gave to Parliament last year, the moment they operated trains from Baker Street to Aldgate and took the Circle trains off, they were under an obligation to carry out these "Circle" works of £860,000.

The Upminster line improvements were to enable them to give a full service of 38 trains an hour, right down to Upminster, if need be, either off the District or Metropolitan lines. It was at present limited to 28. The cost of running the additional trains based on the cost of working the existing service to Upminster was 4·1 pence per car-mile.

After hearing Mr. Pick's evidence, the committee was satisfied as to the financial position and found the preamble proved.

In the discussion on clauses, the question of uniformity of fares was brought up. Mr. Pick explained that the Board had taken over a whole group of railways with different powers of charging. On the tube railways a fraction of a mile might be charged as a mile, and therefore there were no statutory halfpenny fares. Upon the District and the Metropolitan lines the main line railways fraction clause operated, a fraction of half a mile being deemed to be half a mile, and therefore there were halfpenny fares. Now that it was proposed to remove through trains off the Metropolitan on to the Bakerloo system they wanted to unify all the fares. They did not want to build a bit of new railway with this fractions clause in existence. There was no intention on the part of the Board to secure more than one minimum fare in respect of one journey. The committee agreed that there should be a clause on the lines proposed by the promoters, provided it was made absolutely clear that there should be no chance of two minima being charged in respect of one journey.

A Railway Artist.—Mr. C. Potter, a clerk at King's Cross Goods station, L.N.E.R., has had two aquatints accepted for this year's exhibition at the Royal Academy. One depicts an electric power station and the other three cranes clearing a site for building. Mr. Potter had an aquatint accepted last year.

Inter-Railway Ambulance Competition

The Wharncliffe Rooms, Hotel Great Central, Marylebone, were the scene of the 34th annual competition for the Inter-Railway Challenge Shield of the St. John Ambulance Association on May 24. Both team and individual tests were well staged; the scenery was provided by Mr. John Maxwell, Chairman, British International Pictures Limited, and personally supervised by Mr. Joseph Grossman, Studio Manager, and added much to the realism of the scenes. The team test represented a colliery accident, while individual tests included accidents in the hunting field and a patient suffering from carbon monoxide poisoning from his car. Dr. A. T. Lakin, M.B., of Manchester, and Dr. A. M. Pollock, M.B., of Tunbridge Wells, were adjudicators of the team and individual work respectively. Among the large number of interested spectators who witnessed the competition were:—

Mr. R. Holland-Martin, C.B., Deputy Chairman, Southern Railway; Mr. J. F. Lean, Principal Assistant to General Manager, G.W.R.; Major Gilbert S. Szlumper, C.B.E., Assistant General Manager, Southern Railway; Mr. R. Carpmael, Chief Engineer, G.W.R.; Mr. G. F. Thurston, Divisional General Manager, Southern Area, L.N.E.R.; Mr. W. E. C. Lazenby, Assistant Chief Officer, Labour and Establishment, L.M.S.R.; Mr. O. Cromwell, Assistant to General Manager, Southern Railway; Mr. W. G. Pape, Outdoor Assistant to General Manager, Southern Railway; Dr. H. Cavendish Fuller, Chief Medical Officer, G.W.R.; Mr. A. S. Mills, District Goods Manager, G.W.R.; Mr. H. S. B. Whitley, Divisional Locomotive Superintendent, Wolverhampton, G.W.R.; and Mr. Rayner Smith, Chief Clerk to Divisional Superintendent, Birmingham, G.W.R.

Lt.-Gen. Sir Aylmer Hunter-Weston, K.C.B., Chancellor of the Order of St. John, presided over the subsequent presentation, which he opened by asking the Secretary-General of the Order, Major-General Sir Percival Wilkinson, K.C.B., to announce the result of the competition. This was as follows:—

		Marks
1st	Southern Railway, Horsham (Challenge Shield)	368
2nd	Midland & Great Northern Joint (Corbet Fletcher Cup)	358
3rd	Southern Railway, Waterloo ...	341
4th	L.N.E.R., Tyne Dock	316
5th	L.N.E.R., Dukinfield	302
6th	L.M.S., Agecroft	295½
7th	G.W.R., Small Heath	287½
8th	G.W.R., Fishguard	253
9th	L.M.S., Bushbury	237½

The chairman introduced Sir Robert Horne, P.C., G.B.E., Chairman of the Great Western Railway, and after enumerating the many important public offices which Sir Robert had held, said how honoured the assembly was in having such a distinguished visitor to present the trophy and prizes.

Sir Robert Horne, expressing his pleasure at being present at the final ceremonies of the competition, said the chairman had kindly referred to the variety of his avocations, but these steps in his chequered career only showed how many things he had to learn before he could undertake the management of a great railway. He heartily congratulated the Southern Railway (Horsham) team on winning the Challenge Shield, and said that the Great Western Railway surrendered the trophy with considerable equanimity. No team need feel any acute disappointment, for they had always the award of work well done. Although nearly 30,000 railwaymen passed a first aid examination every year, this was not the extent of their influence. Many cases of first aid rendered by railwaymen were in connection with the general public outside railway premises. They were serving the whole community of the State and the country, and they had the best wishes of all the railway directorates.

Sir Robert then presented the challenge trophy, the Corbet Fletcher Cup, and prizes to individual members of teams, and handed the South Lambeth team (G.W.R.) a tablet commemorating its winning of the shield in 1934. Dr. Lakin gave a valuable and constructive criticism of the work done, and a vote of thanks was passed to the railway companies for the facilities granted to their staffs in furtherance of the movement, and also to the adjudicators and stewards of the competition.

Railway Map of London

Shortly after the formation of the London Passenger Transport Board the British railways combined to produce a map in poster form of the London and suburban area showing the main line railways and underground system. This was produced in August, 1933, and made available to the public in October. At that time it was the most comprehensive map produced for popular display and was therefore warmly appreciated by the travelling public. Nearly 600 passenger railway stations were marked, or, in fact, all within an area extending east to west from Rainham to Uxbridge and north to south from Potters Bar to Purley. Unfortunately, the speed with which this was produced so soon after the beginning of the working life of the London Passenger Transport Board resulted in a number of drafting errors creeping in. Now the British railways have just re-issued this most useful map poster (which is 50 in. by 40 in.) and the opportunity has been taken to bring it thoroughly up to the imprint date it bears—March, 1935—and to eliminate the errors. It indicates in separate colours for each working company all rail routes and the principal roads within a radius of approximately 35 miles of Charing Cross. The position of every station and of golf courses and public parks is clearly shown. Whilst primarily intended for exhibition at stations, copies of the poster may be obtained from any railway, price 2s. 6d.

BRITISH RAILWAY STATISTICS

"The Railway Gazette" monthly table of freight and passenger traffic figures for February, 1935, as compared with the corresponding period in 1934, compiled from the Ministry of Transport Statement No. 183

Description	Great Britain*	Great Western	London & North Eastern	London Midland & Scottish	Southern
PASSENGER TRAIN TRAFFIC—					
Number of passenger journeys (excluding season ticket holders)	86,152,009	6,036,895	12,027,172	19,535,780	14,522,264
Increase (+) or decrease (−)	+ 2,498,882	+ 87,173	+ 190,916	+ 220,497	+ 490,817
Passenger receipts (excluding season ticket holders)	£2,780,295	£345,125	£535,411	£835,471	£586,082
Increase (+) or decrease (−)	+ £28,702	+ £1,693	+ £3,716	+ £57	+ £10,884
Season ticket receipts	£686,968	£42,329	£116,730	£189,647	£211,576
Increase (+) or decrease (−)	+ £13,645	+ £279	− £1,407	− £3,995	+ £13,239
Parcels and miscellaneous traffic receipts (excluding parcels post)	£939,820	£168,917	£284,174	£361,069	£109,118
Increase (+) or decrease (−)	− £938	+ £257	+ £3,107	+ £7,873	− £1,608
FREIGHT TRAIN TRAFFIC—					
Freight traffic (tons) (excluding free-hauled)	22,252,300	5,229,675	9,901,968	10,529,277	1,383,647
Increase (+) or decrease (−)	− 345,478	− 127,389	− 329,009	− 58,699	− 122,903
Net ton-miles (excluding free-hauled)	1,242,994,256	225,402,822	413,661,593	514,162,303	54,454,485
Increase (+) or decrease (−)	− 27,476,564	− 6,555,178	− 18,834,784	+ 3,782,296	− 5,349,942
Average length of haul (miles) (excluding free-hauled)	55·86	43·10	41·78	48·83	39·36
Increase (+) or decrease (−)	− 0·36	− 0·20	− 0·49	+ 0·63	− 0·34
Freight traffic receipts	£6,857,422	£1,142,000	£2,222,800	£2,889,000	£379,244
Increase (+) or decrease (−)	− £154,042	− £22,000	− £70,382	− £26,000	− £34,530
Receipts per ton-mile	1·324d.	1·22d.	1·29d.	1·35d.	1·67d.
Increase (+) or decrease (−)	− 0·001d.	+ 0·01d.	+ 0·02d.	− 0·02d.	+ 0·01d.
Freight train-loads					
Average train-load (tons)	127·58	133·09	133·05	125·71	104·18
Increase (+) or decrease (−)	− 3·21	− 5·14	− 4·88	− 1·13	− 5·16
Net ton-miles—					
Per train engine-hour	1,006·71	1,082·54	1,051·06	973·84	836·77
Increase (+) or decrease (−)	+ 32·34	+ 14·27	+ 14·26	+ 47·39	+ 34·59
Per shunting-hour	861·14	785·05	937·45	897·71	560·32
Per total engine-hour	464·13	455·05	495·50	467·11	335·60
Net ton-miles per route-mile per working day	2,723	2,647	2,879	3,252	1,152
Increase (+) or decrease (−)	− 54	− 73	− 122	+ 26	− 95
Wagon-miles. Total	355,019,145	63,790,451	121,895,147	150,030,303	17,229,847
Increase (+) or decrease (−)	− 6,094,730	+ 401,636	− 3,764,597	− 1,462,568	− 1,121,092
Percentage of loaded to total	66·06	67·10	63·62	67·70	65·47
Wagons per train—					
Total	34·32	34·79	34·93	34·21	31·14
Increase (+) or decrease (−)	− 0·75	− 0·30	− 0·87	− 0·83	− 1·00
Loaded	22·67	23·34	22·22	23·16	20·39
Empty	11·65	11·45	12·71	11·05	10·75
Train-miles. Coaching—					
Per train-hour	15·12	13·96	14·23	14·54	17·63
Per engine-hour	12·15	11·18	11·12	11·13	14·50
Train-miles. Freight—					
Per train-hour	9·26	9·80	9·25	9·03	9·81
Per engine-hour	3·64	3·44	3·77	3·72	3·16
Engine miles. Total	44,893,219	7,087,884	12,372,323	16,630,369	5,882,506
Increase (+) or decrease (−)	+ 359,529	+ 104,249	+ 45,413	+ 178,943	− 1,979
Mileage run by engines. Total train-miles—					
Coaching	21,922,845	2,996,910	5,001,851	6,968,958	4,266,307
Freight	10,343,277	1,833,439	3,489,964	4,385,149	553,339
Engine-hours in traffic. Total	4,849,439	825,244	1,445,586	1,891,504	487,972
Increase (+) or decrease (−)	− 85,128	− 8,764	− 28,880	− 33,283	− 14,204
Shunting miles per 100 train-miles—					
Coaching	7·49	6·86	6·54	8·25	8·37
Freight	73·98	84·30	69·71	69·39	97·86

* All standard gauge railways

Passenger Traffic Statistics: Number of journeys, receipts, and receipts per journey (excluding season ticket holders)—February, 1935

Subject	Great Britain	Great Western	London & North Eastern	London Midland & Scottish	Southern	Cheshire Lines Committee	Liverpool Overhead	London Passenger Transport Board†	Mersey
Full fares—									
Passenger journeys	28,248,434	571,697	984,011	1,290,737	2,262,593	15,523	141,087	22,232,209	74,076
Gross receipts	£670,328	£50,358	£83,934	£86,198	£135,674	£1,981	£1,425	£297,364	£1,288
Receipts per passenger journey	5·70d.	21·14d.	20·47d.	16·03d.	14·39d.	30·63d.	2·42d.	3·21d.	4·17d.
Reduced fares—									
Excursion and week-end—									
Passenger journeys	30,816,789	3,350,715	7,037,490	10,838,703	6,697,678	322,128	63,030	1,067,823	557,412
Gross receipts	£1,515,981	£232,447	£339,902	£549,704	£322,396	£16,499	£521	£22,754	£8,069
Receipts per passenger journey	11·81d.	16·65d.	11·59d.	12·17d.	11·55d.	12·29d.	1·98d.	5·11d.	3·47d.
Workmen—									
Passenger journeys	24,036,088	1,768,285	3,220,674	6,497,812	5,012,828	214,594	196,490	6,124,402	183,350
Gross receipts	£347,084	£25,835	£51,579	£103,206	£82,090	£3,658	£1,612	£67,729	£1,669
Receipts per passenger journey	3·47d.	3·51d.	3·84d.	3·81d.	3·93d.	4·09d.	1·97d.	2·65d.	2·18d.
Other descriptions—									
Passenger journeys	3,048,462	346,198	734,425	907,284	548,771	45,474	39,226	312,961	9,015
Gross receipts	£243,726	£36,485	£59,223	£94,367	£45,538	£3,308	£252	£2,556	£150
Receipts per passenger journey	19·19d.	25·29d.	18·12d.	24·96d.	19·92d.	17·46d.	1·54d.	1·96d.	3·99d.
Total—									
Passenger journeys	86,152,009	6,036,895	12,027,172	19,535,780	14,522,264	597,745	439,833	29,737,395	823,853
Gross receipts	£2,780,295	£345,125	£535,411	£835,471	£586,082	£24,469	£3,810	£390,403	£11,176
Receipts per passenger journey	7·75d.	13·72d.	10·68d.	10·26d.	9·69d.	10·23d.	2·08d.	3·15d.	3·26d.

† Includes passengers originating on the railway undertakings, and on the Whitechapel and Bow Joint Railway

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NOTES AND NEWS

Progress of Railway Bills.—The London & North Eastern Railway Bill and the Southern Railway Bill were read the third time and passed in the House of Commons on May 27. In the House of Lords they received a first reading on May 28 and were referred to the Examiners.

Guarantee to Canadian Railways.—A Bill has been passed by the Canadian House of Commons authorising the expenditure of a large sum on public works, and guaranteeing $15,000,000 to the Canadian National and Canadian Pacific Railways to be spent on railway equipment.

New P.O. Sorting Carriages.—The L.M.S.R. has recently completed, at Wolverton works, three new Post Office sorting carriages for the London-Aberdeen service. All three vehicles are 60 ft. long and 8 ft. 8 in. wide. They are similar to those described and illustrated in THE RAILWAY GAZETTE of September 7, 1934.

Road Accidents.—The Ministry of Transport return for the week ended May 25 of persons killed or injured in road accidents is as follows. The figures in brackets are those for the corresponding week of last year :—

	Killed, including deaths resulting from previous accidents	Injured
England	83 (126)	3,446 (4,733)
Wales	4 (7)	132 (244)
Scotland	7 (14)	385 (382)
	94 (147)	3,963 (5,359)

The total fatalities for the previous week were 112, as compared with 127 for the corresponding period of last year.

Mozambique Railcars.—Two six-wheeled twin-engined petrol railcars have been built at the Durban shops of the South African Railways for the 3-ft. 6-in. Lourenço Marques Railway, in Mozambique, which is owned by the Portuguese Government. These cars are now in mixed service between Lourenço Marques and Goba, a distance of 85 miles. They are driven by two Hudson 90 b.h.p. engines each coupled to a three-speed gearbox. The carrying capacity on a tare weight of 13·4 tons is five first-class and eight third-class passengers and 4¼ tons of milk, vegetables and parcels. It will be remembered that this railway also has some pneumatic-tyred Micheline railcars, referred to in our issue of July 6 last.

Reduced Sleeping Pullman and Restaurant Car Charges in France.—The French railways and the International Sleeping Car Company announce considerable reductions in their charges for sleeping and Pullman accommodation on French trains as from May 16. In the case of first-class sleepers, lits-salons and couchettes, the reduction varies, in most instances, between approximately 15 per cent. and 25 per cent. Further reductions are available to parties travelling with family tickets. The International Sleeping Car Company also announces reductions in restaurant car charges on the French railways, amounting to approximately 20 per cent. in most cases.

Canadian Pacific Earnings.—Gross earnings of the Canadian Pacific Railway for the month of April, 1935, amounted to $9,987,000, an increase of $727,000 compared with April, 1934, and working expenses were $8,574,000, an increase of $585,000, leaving net earnings $142,000 higher, at $1,413,000. Aggregate gross earnings from January 1 to the end of April, 1935, amounted to $36,425,000, a decrease of $322,000 compared with the corresponding period in 1934, and the aggregate net earnings of $3,515,000 showed a falling off of $982,000.

Canadian National Earnings.—For the month of April, 1935, gross earnings of the Canadian National Railways amounted to $14,006,144, an increase of $559,140 in comparison with April, 1934. Operating expenses ($12,476,428) at the same time advanced by $535,635, leaving net earnings $23,505 higher, at $1,529,716. Aggregate gross earnings from January 1 to April 30, 1935, were $52,382,544, an improvement of $1,569,098 on the first four months of 1934, and there were aggregate net earnings of $2,017,078, an increase of $445,866.

L.M.S.R. Silver Jubilee to Visit North of England and Scotland.—*Silver Jubilee*, the L.M.S.R. chromium-plated locomotive which has been named in honour of the Jubilee, is shortly to visit Scotland and a number of centres in the North of England and the Midlands. The engine has been withdrawn from the Euston–Manchester service on which it was first put into traffic, and for the next fortnight will be running between London (St. Pancras), Leicester, and Nottingham. At the end of this period it will be stationed for a further three weeks at the Newton Heath depot (Manchester), and will be employed on express trains between Manchester, Preston, Carlisle, and Glasgow. These special workings have been arranged in consequence of the great interest which has been aroused among the travelling public and L.M.S.R. staff by the engine's distinctive appearance, and will enable it to visit as many centres as possible consistent with traffic requirements.

Railway Benevolent Institution.—The seventy-seventh annual meeting of the members of this institution will be held in the Board Room, L.N.E.R., King's Cross station, N.1, on Monday, June 24, at 4.0 p.m., to receive the report of the board of management, grant permanent annuities to 131 widows, two members, and admit to school benefits two children in the officers' department, also to grant permanent annuities to 60 widows and 69 members in the servants' department, and to transact the ordinary business of the institution. The board will appoint to contingent annuities 17 widows in the officers' department, and 911 widows and 414 members in the servants' department, being applicants in excess of the number of permanent annuities to be granted. There will be no ballot on this occasion.

Names for R.A.S. Planes.—The planes used by Railway Air Services Limited on the Liverpool-Brighton and Plymouth-Nottingham services have been named, respectively, *The City of Birmingham* and *The City of Bristol*, and *The City of Plymouth* and *The City of Cardiff*. The names appear in large green letters on the fuselage of the machines.

Electric Cooking on L.N.E.R. Trains.—In developing its policy of electric cooking in restaurant cars, the L.N.E.R. is having additional charging appliances installed at Liverpool Street, Clacton, Ely, Hunstanton, Norwich, Hull, Glasgow, Fort William, and Mallaig. The additional charging facilities will enable more extensive use to be made of electrically-fitted restaurant car kitchens.

Cheap Evening Return Tickets to London.—In conjunction with London Transport, the G.W.R., L.M.S.R., and L.N.E.R. announce the introduction of third class cheap evening return tickets, available at or after 5 p.m., to points in Central London from a radius of roughly 20 miles, at a lower rate than cheap day tickets. These special evening tickets will be available from many London suburban stations to central points in the West End of London on the underground railways of the board ; tickets will also be available from comparable suburban stations on the board's system, but the number of these will naturally be smaller. The scheme will come into force tomorrow, June 1. Where the ordinary third single to the main line company's terminus is up to 1s. 6d., the evening returns to West End stations are 1s. ; where between 1s. 6d. and 2s., they are 1s. 3d. ; and for fares up to 2s. 6d., the evening tickets are 1s. 6d.

Northern Belle Cruises.—The first Northern Belle cruise of the 1935 season leaves King's Cross station, L.N.E.R., at 9.0 tonight (Friday). Subsequent tours will be run on June 7, 21, and 28, departing at the same time and reaching London again at 10.45 a.m. on the following Friday. Slight modifications have been made in last year's itinerary, the most noteworthy change being an extension from Aberdeen to Grantown-on-Spey, whence Aviemore will be visited by motor coach. The visit to Harrogate is not being repeated. Other road and steamer excursions are arranged from various calling places. The Northern Belle cruises have already earned popularity among visitors from the Continent, for whose convenience a £25 inclusive fare

has now been arranged to include first class return travel by rail and steamer between the Hook of Holland, Flushing, or Antwerp, and London, with a sightseeing tour of the capital before leaving King's Cross. The all-in fare for British travellers is £20.

An L.N.E.R. Travelling Cinema.—The inauguration of the new L.N.E.R. travelling talkie cinema to be provided on the 10.10 a.m. up and 3.15 p.m. down London-Leeds expresses took place on Monday last when Mr. J. H. Thomas, Secretary of State for the Dominions, was present at the departure of the down train at King's Cross. The cinema is fitted in an L.N.E.R. van; two-thirds of the space is equipped as an auditorium, and the remaining third utilised as the projecting room. The auditorium is suitably decorated with silver panelling, and 44 tip-up seats are provided on a sloping floor. The films are projected on to the screen from the rear thereof. An attendant in uniform will announce to passengers the performances which are to be given in the theatre, and a charge of one shilling will be made for admission to each performance, which will be of approximately an hour's duration. In addition, passengers will be able to ascertain the films to be shown during the journey from boards hung on the exterior of the coach. The talkie apparatus has been supplied by Pathé Equipment Limited and the films will be provided by Pathé Pictures Limited.

L.M.S. Glasgow Hotel Improvements.—Work has been begun by the L.M.S.R. on a scheme of improvements at the St. Enoch Hotel, Glasgow, including the installation of running hot and cold water, central heating, and additional bath-rooms. There is at present in hand the fitting of 50 bedrooms with central heating and running hot and cold water, and the provision of seven extra public bathrooms. It is expected that the improvements will be completed before Whitsun.

British and Irish Traffic Returns

GREAT BRITAIN	Totals for 21st Week			Totals to Date		
	1935	1934†	Inc. or Dec.	1935	1934	Inc. or Dec.
	£	£	£	£	£	£
L.M.S.R. (6,926¼ mls.)						
Passenger-train traffic...	438,000	495,000	– 57,000	8,591,000	8,555,000	+ 36,000
Merchandise, &c. ...	466,000	363,000	+ 103,000	9,376,000	9,314,000	+ 62,000
Coal and coke ...	215,000	141,000	+ 74,000	5,155,000	5,181,000	– 26,000
Goods-train traffic ...	681,000	504,000	+ 177,000	14,531,000	14,495,000	+ 36,000
Total receipts	1,119,000	999,000	+ 120,000	23,122,000	23,050,000	+ 72,000
L.N.E.R. (6,336 mls.)						
Passenger-train traffic...	279,000	325,000	– 46,000	5,628,000	5,559,000	+ 69,000
Merchandise, &c. ...	320,000	281,000	+ 39,000	6,445,000	6,551,000	– 106,000
Coal and coke ...	221,000	152,000	+ 69,000	4,858,000	4,993,000	– 135,000
Goods-train traffic ...	541,000	433,000	+ 108,000	11,303,000	11,544,000	– 241,000
Total receipts	820,000	758,000	+ 62,000	16,931,000	17,103,000	– 172,000
G.W.R. (3,749¼ mls.)						
Passenger-train traffic...	176,000	197,000	– 21,000	3,575,000	3,601,000	– 26,000
Merchandise, &c. ...	192,000	149,000	+ 43,000	3,743,000	3,713,000	+ 30,000
Coal and coke ...	101,000	64,000	+ 37,000	2,141,000	2,167,000	– 26,000
Goods-train traffic ...	293,000	213,000	+ 80,000	5,884,000	5,880,000	+ 4,000
Total receipts	469,000	410,000	+ 59,000	9,459,000	9,481,000	– 22,000
S.R. (2,171 mls.)						
Passenger-train traffic...	270,000	305,000	– 35,000	5,377,000	5,311,000	+ 66,000
Merchandise, &c. ...	62,000	59,500	+ 2,500	1,241,500	1,324,000	– 82,500
Coal and coke ...	27,000	19,500	+ 7,500	663,500	705,000	– 41,500
Goods-train traffic ...	89,000	79,000	+ 10,000	1,905,000	2,029,000	– 124,000
Total receipts	359,000	384,000	– 25,000	7,282,000	7,340,000	– 58,000
Liverpool Overhead ... (6½ mls.)	1,130	1,386	– 256	23,277	22,875	+ 402
Mersey (4½ mls.) ...	3,663	4,210	– 547	85,672	87,829	– 2,157
*London Passenger Transport Board ...	543,200	577,200	– 34,000	25,211,800	24,673,600	+ 538,200
IRELAND						
Belfast & C.D. pass. (80 mls.)	2,183	2,100	+ 83	40,459	39,040	+ 1,419
,, ,, goods	549	486	+ 63	10,416	11,146	– 730
,, ,, total	2,732	2,586	+ 146	50,875	50,186	+ 689
Great Northern pass. (543 mls.)	8,350	9,550	– 1,200	180,750	164,950	+ 15,800
,, ,, goods	10,850	8,500	+ 2,350	186,650	180,150	+ 6,500
,, ,, total	19,200	18,050	+ 1,150	367,400	345,100	+ 22,300
Great Southern pass. (2,124 mls.)	19,300	23,876	– 4,576	427,717	419,332	+ 8,385
,, ,, goods	31,566	30,139	+ 1,427	739,780	679,784	+ 59,996
,, ,, total	50,866	54,015	– 3,149	1,167,497	1,099,116	+ 68,381

* 47th week, the receipts for which include those undertakings not absorbed by the L.P.T.B. in the corresponding period last year; last year's figures are, however, adjusted for comparative purposes

† 1934 figures include Whitsun Monday

British and Irish Railways Stocks and Shares

Stocks	Highest 1934	Lowest 1934	Prices May 29, 1935	Rise/Fall
G.W.R.				
Cons. Ord. ...	66½	48½	48½	–½
5% Con. Prefce. ...	118	109	119	–½
5% Red. Pref. (1950)	115	107	111½	—
4% Deb.	117	105	115½	+½
4½% Deb.... ...	119	109	116½	—
4½% Deb.... ...	129½	115¼	125½	–1
5% Deb.	135	126¼	137½	—
2½% Deb.... ...	75	64	78½	+½
5% Rt. Charge ...	134 7/16	123¼	135½	+1
5% Cons. Guar. ...	132¾	121¾	130½	—
L.M.S.R.				
Ord.	30½	19½	18	+½
4% Prefce. (1923)	64¼	41	51	–½
4% Prefce. ...	87	69½	79½	–1
5% Red. Pref. (1955)	107	92½	102½	—
4% Deb.	114⅛	100½	108½	–1
5% Red. Deb. (1952)	118 11/16	111¼	115½	—
4% Guar.	106½	96¾	103	—
L.N.E.R.				
5% Pref. Ord. ...	24¾	13½	11	–½
Def. Ord.	11½	6⅞	5¾	–⅛
4% First Prefce. ...	76	59½	59½	–1
4% Second Prefce.	47	25½	22	–½
5% Red. Pref. (1955)	94½	80	80⅛	–1
4% First Guar. ...	104	92	100½	–½
4% Second Guar.	97⅞	86½	93	–½
3% Deb.	90	74½	83	–1½
4% Deb.	114	99¼	107½	–½
5% Red. Deb. (1947)	117	108	113½	—
4½% Sinking Fund Red. Deb.	111¼	105¼	111	—
SOUTHERN				
Pref. Ord.... ...	90	63⅛	85	–1
Def. Ord.	32⅝	19	23	–½
5% Prefce. ...	118 3/16	107½	119½	–1
5% Red. Pref. (1964)	115¾	107½	115½	—
5% Guar. Prefce.	132	120¾	130	+½
5% Red. Guar. Pref. (1957)	119½	113	118½	—
4% Deb.	116½	103¼	114½	—
5% Deb.	134	124 13/16	135½	—
4% Red. Deb. 1962–67	113 11/16	105 9/16	112½	—
BELFAST & C.D.				
Ord.	6	5	4	–1
FORTH BRIDGE				
4% Deb.	110	100	109½	—
4% Guar.	110	100	108½	—
G. NORTHERN (IRELAND)				
Ord.	9¾	4 15/16	9	—
G. SOUTHERN (IRELAND)				
Ord.	25	12½	25	—
Prefce.	21½	13 15/16	32	+7
Guar.	48	39	65	+5
Deb.	67	59	78	+3
L.P.T.B.				
4½% "A" ...	126	115	125½	—
5% "A"	135½	124½	135½	—
4½% "T.F.A." ...	113½	107½	112	—
5% "B"	131¾	118	129½	+1
"C"	97	73	100	—
MERSEY				
Ord.	15¼	7	12	—
4% Perp. Deb. ...	93½	82½	95½	—
3% Perp. Deb. ...	66½	61½	69½	—
3% Perp. Prefce....	54	44½	52½	—

XUM

CONTRACTS AND TENDERS

R. Y. Pickering & Co. Ltd. has received an order from the National Benzol Co. Ltd. for twelve 14-ton tank wagons for the conveyance of class A inflammable liquids.

Welded Double-framed Passenger Bogies for India

G. H. Sheffield & Co. Ltd. has received an order from the Bombay, Baroda & Central India Railway, to the inspection of Messrs. Rendel, Palmer & Tritton, for eight metre-gauge Sheffield-Twinberrow patent welded double-framed passenger coach bogies, 6 ft. 6 in. wheelbase; with Skefko roller-bearing axleboxes, but without wheels and axles.

The Bombay, Baroda & Central India Railway has also placed the following orders, to the inspection of Messrs. Rendel, Palmer & Tritton :—

Thos. Firth & John Brown Limited: 147 locomotive axles.
Geo. Turton, Platts & Co. Ltd.: 550 carriage and wagon buffers.
Davies & Metcalfe: 30 vacuum brake ejectors.
Superheater Co. Ltd.: 50 sets of superheater elements.
Steel, Peech & Tozer Limited: 50 sorbitic tyres for electric rolling stock.
Miller & Co. Ltd.: 200 chilled cast-iron wheels.
Hugh Gordon & Co. Ltd.: 15 copper firebox plates.
Vereingte Deutsche Metallwerke: 35 copper firebox plates.

The Monkbridge Iron & Steel Co. Ltd. has received an order for 996 steel locomotive tyres for the Buenos Ayres Great Southern Railway and 356 steel locomotive tyres for the South Indian Railway.

The South Indian Railway Administration has also placed orders to the inspection of Messrs. Robt. White & Partners, as follow :—

Bruce Peebles & Co. Ltd.: Two 250 kVA. transformers.
P. & W. MacLellan Limited: 197½ tons steel bars, plates and sheets.
Steel, Peech & Tozer Limited: 20½ tons of spring steel.
J. Spencer & Son (1928) Ltd.: Approx. 530 helical and volute springs.
Mather & Platt Limited: Six train-lighting dynamos and switchgear.

The Yorkshire Engine Co. Ltd. has received an order from the Central Uruguay Railway for four mild-steel locomotive fireboxes.

D. Wickham & Co. Ltd. has received orders from the L.N.E.R. for three petrol-driven permanent-way gang trolleys and three trailers.

Leyland Motors Limited has received an order for ten Titan passenger vehicles for the Eastern Counties Omnibus Company.

Tangyes Limited has received an order for one 350-ton capacity electrically-driven hydraulic wheel press for the Entre Rios Railways.

The Associated Equipment Co. Ltd. has received repeat orders for four oil-engined Regent vehicles for the London Passenger Transport Board; five oil-engined Regal vehicles for the Northern General Transport Co. Ltd.; and two Marshall oil-engined, one Mammoth Major eight-wheeled, oil-engined, and three special low loader oil-engined vehicles for Pickfords Limited.

The Michelin Company, of Clermont-Ferrand, has placed a repeat order for five Cotal electrically-operated gearboxes for installation in pneumatic-tyred railcars. The Cotal gearbox is marketed in Britain by the Cotal Chadburn Co. Ltd., and this firm has placed an order with Bean's Industries Limited, Tipton, for two gearboxes suitable for diesel railcars.

Machine Tools and Equipment for India.

Alfred Herbert (India) Limited has received an order from the Great Indian Peninsula Railway for one Ormerod 14-in. high-speed belt-driven shaping machine to be supplied by Ormerod Shapers Limited.

Craven Bros. (India) Limited has received an order from the Great Indian Peninsula Railway for one Wadkin belt driven 26-in. circular saw bench manufactured by Wadkin & Co.

Guest, Keen, Williams, Limited has received an order from the Great Indian Peninsula Railway for one combined twist drill and tool grinding machine to be manufactured by Luke & Spencer Limited.

Heatly & Gresham Limited has received orders from the Great Indian Peninsula Railway for three Greenbat standard 2-ton electric battery trucks with Exide Iron-clad batteries to be supplied by Greenwood & Batley Limited.

Cowans, Sheldon & Co. Ltd. has recently received an order from the Chinese Government Purchasing Commission to construct a locomotive turntable, as announced in this column in our issue of April 26. The turntable, which is being supplied to the inspection of the consulting engineers, Messrs. Fox & Mayo, is to be 30 m. diameter and capable of turning engines weighing up to 330 tons. It will be of the articulated type, as manufactured by Cowans, Sheldon & Co. Ltd. under the Vogele patents, and will be the largest turntable of this type which has so far been constructed in this country.

Soviet Orders Placed in Great Britain

The orders placed in Great Britain by Soviet trading organisations in April of this year amounted to £589,296 as compared with £1,223,018 in April, 1934. The total value of the orders placed in the first four months of this year amounted to £3,328,246 as compared with £3,449,335 in the corresponding period last year. The following table shows the orders placed for engineering equipment during the respective periods :—

	April, 1935	April, 1934	Jan.-April, 1935	Jan.-April, 1934
	£	£	£	£
Machinery and equipment ..	82,786	62,011	843,415	344,167
Ferrous alloys	47,875	5,661	108,942	65,999
Steel ..	19,988	427,913	234,532	636,676
Non-ferrous metals ..	202,432	451,398	719,231	1,045,726

The orders for machinery and equipment have increased this year by 145 per cent., and for ferrous alloys by 65 per cent. There was a serious reduction in the orders for steel and non-ferrous metals.

Tubes Limited has received an order for 300 Resistco steel boiler tubes and 50 steel superheater smoke tubes for the Antofagasta (Chili) & Bolivia Railway.

New Mechanical Departure Indicator at Paddington

A new electrical indicator which tells passengers the time, destination and platform of departure trains has recently been installed at Paddington station, G.W.R. This indicator is enclosed in a glass-fronted case 10 ft. high by 6 ft. wide on the opposite side of the mechanical arrival indicator described in THE RAILWAY GAZETTE for April 6, 1934. To look at, it is like a large venetian blind with twenty-nine metal slats on each of which is painted the time of a train and the principal stations at which it calls *en route*. Each of these slats is clipped, with ten others, to endless belts which run inwards at right-angles to the face of the indicator so that only at the turn is one slat on each belt displayed. The platform numbers are worked independently of the slats so that any alterations can be adjusted immediately.

The face of the indicator is changed by an electric motor situated inside the casing which automatically sets in motion, at intervals during the twenty-four hours, the twenty-nine endless belts, thus erasing the one setting and bringing into view the next set of trains. In order that the information shall be shown well in advance, the bottom two or three trains in the previous setting are carried forward to the top of the fresh setting at each change. The times of these changes, the addition or deletion of trains and altered platform numbers can be previously arranged in very much the same way as one sets an alarm clock by merely plugging in to the appropriate socket on a large panel housed fifty yards away from the indicator. Provision is made on the indicator, for instance, to display the additional trains which run on Saturdays. This can be done by merely inserting the necessary plugs at any time within the previous twenty-four hours, and, on the Saturday, the indicator will show the extra trains, in their correct time order, in addition to the normal service. The total number of departing trains which can be shown daily is 290. The equipment has been manufactured by Siemens & General Electric Railway Signal Co. Ltd.

OFFICIAL NOTICES

THE MADRAS & SOUTHERN MAHRATTA RAILWAY CO. LTD. invite Tenders for :—
21 BOILERS FOR LOCOMOTIVES, BROAD GAUGE, viz. :—

4 Boilers for A.S. 4-6-0 Type Passenger Locomotives.
6 Boilers for D.S. 2-8-0 Type Goods Locomotives.
9 Boilers for V.S. 0-6-0 Type Goods Locomotives.
1 Boiler for X.B. 4-6-2 Type Light Passenger Locomotive.
1 Boiler for X.D. 2-8-2 Type Light Goods Locomotive.

Specification and Form of Tender can be obtained at the Company's Offices, 25, Buckingham Palace Road, Westminster, London, S.W.1.
Fee ONE GUINEA, *which will not be returned.*
Tenders must be submitted not later than 2 o'clock p.m. on TUESDAY, 18TH JUNE, 1935.
The Directors do not bind themselves to accept the lowest or any tender and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
G. W. V. DE RHE PHILIPE,
Secretary.

London & North Eastern Railway Company

NOTICE is hereby given that, for the purpose of preparing the warrants for Interest on the Company's 3 per cent. and 4 per cent. Debenture Stocks and 4½ per cent. Sinking Fund Debenture Stock for the half-year ending 30th June, 1935, the balances will be struck as at the close of business on 12th June, and Interest will be payable only to those Stockholders whose names are registered on that date.
Transfers of the above mentioned Stocks should, therefore, be lodged with the Registrar of the Company at Hamilton Buildings, Liverpool Street Station, London, E.C.2, before 5 p.m. on 12th June.

By Order,
JAMES McLAREN,
Secretary.
Marylebone Station,
London, N.W.1.
31st May, 1935.

PATENTS for Inventions, Trade Marks, Advice, Handbook, and consultations free. King's Patent Agency, Ltd. (B. T. King, C.I.M.E., Registered Patent Agent, G.B., U.S., and Canada), 146A, Queen Victoria Street, London, E.C.4. 49 years' references. 'Phone City 6161.

Universal Directory of Railway Officials and Railway Year Book

40th Annual Edition, 1934-35

Price 20/- net.

This unique publication gives the names of all the principal railway officers throughout the world, together with essential particulars of the systems with which they are connected. Much general and statistical information about railways is also concisely presented.

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33, Tothill Street, London, S.W.1.

OFFICIAL ADVERTISEMENTS intended for insertion on this page should be sent in as early in the week as possible. The latest time for receiving official advertisements for this page for the current week's issue is noon on Thursday. All advertisements should be addressed to :—*The Railway Gazette*, 33, Tothill Street, Westminster, London, S.W.1.

RAILWAY AND OTHER REPORTS

Bombay, Baroda & Central India Railway.—The directors will propose, at the general meeting to be held in July next, the payment, in addition to the half year's guaranteed interest of £1 10s. per cent., of a final dividend for the financial year ended March 31, 1935, of £1 10s. per cent., making a total payment in July next of £3 per cent., less income tax. The return on the capital stock for the whole year will therefore be £6 per cent., less income tax, the same as for the previous year.

Emu Bay Railway Co. Ltd.—After making the usual provision for depreciation, there was a loss for the year 1934 of £3,503, and after taking credit for an adjustment in taxes of £447, the debit balance carried forward has been increased to £6,662. It has not been possible to make any payment on account of interest for the twelve months to the holders of either the 4½ per cent. or the 5 per cent. irredeemable debenture stock. Gross revenue for the year showed a falling off from 1933, mainly due to the low output of minerals from the mines. The Zeehan-Dundas section is still closed for train traffic as no freight is offering.

Festiniog Railway.—Receipts for the year 1934 amounted to £11,742, against £9,735 in 1933, and expenditure rose from £8,394 to £10,423, leaving net receipts of £1,318 against £1,341. Net revenue for 1934 amounted to £1,022, against £760. This covered the £632 interest on the £15,800 of 4 per cent. debenture stock, and the debit balance of £6,578 brought in has been reduced to £6,188. There was an improvement both in slate and holiday passenger traffic. The credit on net revenue account is in excess of that shown for many years. This was made possible after protracted negotiations resulting in reductions in the debenture and bank interest and in the rents and tolls payable. In July of last year the company took over the operation of the Welsh Highland Railway under lease.

Chicago, Burlington & Quincy Railroad.—Operating revenues for the year 1934 were $80,288,159, against $78,496,795 for 1933, but expenses rose from $54,361,598 to $58,007,982, and net operating revenues fell from $24,135,377 to $22,280,177. Non-operating income in 1934 was also slightly lower, and gross income amounted to $13,905,104, against $15,053,054 in 1933. Net income totalled $4,454,760, or $1,143,263 less than in 1933.

A.B.C. Coupler & Engineering Co. Ltd.—The loss for the year to September 30 last was £6,754 (against loss of £9,887 for the previous year) which, added to the debit brought in, makes a total debit of £29,438. Nearly half of the year's loss was accounted for by amounts for depreciation and writing off of patents abandoned. Competition remained very severe, but the outlook is now more encouraging, as sales have been considerably higher than in 1934, and the orders now on the books are approximately double those of a year ago.

Maidstone & District Motor Services Limited.—Controlled jointly by the Southern Railway Company and Tilling & British Automobile Traction Limited, this company secured for the year ended March 31, 1935, a net profit of £74,528, to which must be added £20,164 brought forward from the previous year, making a total of £94,692. The dividend on the 6½ per cent. cumulative preference shares takes £13,000, and the dividend for the whole year of 12½ per cent. on the ordinary shares will require £50,000. It is proposed to add £11,500 to the reserve fund and to carry forward £20,192. The authorised capital has been increased during the year to £700,000 by the creation of £200,000 additional shares of £1 each, of which 100,000 shares have been issued as ordinary shares. The business of the company has been further extended by the purchase, in February, of the properties and operating assets of Redcar Services Limited, of Tunbridge Wells.

L.N.E.R. PUNCTUALITY.—The L.N.E.R. advises us that every one of the 168 trains into Liverpool Street station yesterday (Thursday) morning between seven and eleven o'clock was on time, except the 8.2 a.m. from Hertford, which was one minute late owing to permanent way repairs.

Forthcoming Meetings

June 4 (*Tues.*)—**Antofagasta (Chili) & Bolivia Railway Co. Ltd.** (Annual General), Winchester House, Old Broad Street, E.C., at 12 noon.

Forthcoming Events

May 31 (*Fri.*).—Banquet at Savoy Hotel, London, 7.30 for 8 p.m., to celebrate Colonel R. E. B. Crompton's Ninetieth Birthday, The Hon. Sir Arthur Stanley, G.B.E., C.B., M.V.O., in the Chair.
The Railway Club, at Royal Scottish Corporation Hall, Fetter Lane, E.C.4, at 7.30 p.m. "How the Railways Fight the Snow," by Mr. H. A. Vallance.
June 1 (*Sat.*).—Permanent Way Institution (Manchester–Liverpool), at Temperance Inst., Southport, 3 p.m. *Discussion :* "Mining Subsidence and Permanent Way Maintenance."
Permanent Way Institution (London). Visit to Reconstruction Work at Moorgate Station (Morden and Edgware Line), 3 p.m.
June 3 (*Mon.*).—Indian State Railways, at Café Monico, Shaftesbury Avenue, London, W.1, 7 for 7.30 p.m. Annual Dinner.
June 4–6.—Tramways, Light Railways and Transport Association, at Llandudno. Annual Congress.
June 12 (*Wed.*).—Institution of Civil Engineers, Great George Street, London, S.W.1. Conversazione.
June 20 (*Thurs.*)—Institution of Electrical Engineers, at Natural History Museum, Cromwell Road, London, S.W. 7, 8.30 p.m. Conversazione.
June 21–24.—Institution of Railway Signal Engineers, in Belgium. Summer Meeting.
June 25 (*Tues.*)—Retired Railway Officers' Society. Summer Outing.

XUM

Railway Share Market

The stock and share markets have been quiet during the week. Home railway stocks have not been any more active than other sections of the Stock Exchange. The check in the flow of business is not to be wholly attributed to the hasty publicity given in some quarters to the possible reopening of wage "cut" negotiations. Traffic receipts were not regarded as unfavourable. Apart from the Southern "take" the returns posted up in the Stock Exchange on Wednesday had a good reception, as they indicated that movement of goods traffic in the areas served by the Great Western, North Eastern and L.M.S. is expanding.

The Southern drop of £25,000 was disappointing as it had been hoped that passenger receipts would be maintained. The net effect has been a fall in Southern preferred and deferred ordinary stocks, the latter being now about two points below the level of a month ago. The increasing activity in the iron and steel industries, as shown by the reports of some of the steel manufacturing concerns, has stimulated buying of London & North Eastern first preference stock which, it is estimated in the market, is now earning the full 4 per cent. to which the stock is entitled. On this basis the yield is the high one of £6 13s. 4d. per cent., or about 2 per cent. more than is obtainable on an industrial company's ordinary share. Viewed from this angle the stock is considered in the Stock Exchange to be worth more attention than it receives as a "recovery" investment. London Transport "C" stock remained at around 100 on the prospects of dividend increase for the year. In the foreign railway market the chief feature was the strong buying of Cordoba Central first debenture stock and the income debenture stock, both of which proved to be in short supply.

The current quotation of the first debentures is about ten points higher than ruled earlier in the year, although it is still below the level reached at one time last year when there was a confident rumour that the Argentine Government were on the point of making an offer to the company equivalent to about 50 per cent. for the stock. At present it is merely known that negotiations are proceeding somewhat uncertainly and there is no workable basis for valuing the stock. Any prospective buyers must be prepared to accept the market's estimate which is not necessarily to be regarded as accurate. Most other Argentine railway stocks moved against holders.

Traffic Table of Overseas and Foreign Railways Publishing Weekly Returns

	Railways	Miles open 1934-35	Week Ending	Traffics for Week: Total this year	Traffics for Week: Inc. or Dec. compared with 1934	No. of Weeks	Aggregate Traffics to Date: Totals: This Year	Aggregate Traffics to Date: Totals: Last Year	Aggregate Traffics to Date: Increase or Decrease	Shares or Stock	Prices: Highest 1934	Prices: Lowest 1934	Prices: May 29, 1935	Yield % (See Note)
				£	£		£	£	£					
South & Central America.	Antofagasta (Chili) & Bolivia	830	26.5.35	11,520	+ 1,060	21	259,520	267,730	— 8,210	Ord. Stk.	265¼	19	19	Nil
	Argentine North Eastern ..	753	25.5.35	8,103	— 185	47	349,688	386,839	— 37,151	,,	11	6⅞	7	Nil
	Argentine Transandine ..	111	—	—	—	—	—	—	—	A. Deb.	52	45	40	10
	Bolivar	174	Apl., 1935	6,750	+ 350	17	26,300	27,050	— 750	6 p.c. Deb.	10	6½	10	Nil
	Brazil	—	—	—	—	—	—	—	—	Bonds.	135¼	107/16	13	3¹⁵/₁₆
	Buenos Ayres & Pacific ..	2,806	25.5.35	95,345	+ 10,451	47	3,734,926	4,029,453	— 294,527	Ord. Stk.	16⅝	8½	7½	Nil
	Buenos Ayres Central ..	190	12.5.35	$114,300	+ $7,500	45	$4,934,300	$4,780,600	+ $153,700	Mt. Deb.	23	10	21½	Nil
	Buenos Ayres Gt. Southern	5,085	25.5.35	123,689	+ 13,178	47	6,771,103	7,339,951	— 568,848	Ord. Stk.	35	22	23	Nil
	Buenos Ayres Western ..	1,930	25.5.35	47,142	+ 5,040	47	2,136,422	2,484,800	— 348,378	,,	27½	18½	17½	Nil
	Central Argentine	3,700	25.5.35	144,390	+ 17,460	47	5,720,327	6,165,268	— 444,941	,,	23	13½	14½	Nil
	Do.	—	—	—	—	—	—	—	—	Dfd.	14	7	7	Nil
	Cent. Uruguay of M. Video	273	25.5.35	9,805	— 6,376	47	637,941	771,150	— 133,209	Ord. Stk.	15½	8	5½	Nil
	Do. Eastern Extn.	311	25.5.35	2,012	— 1,488	47	91,220	160,097	— 68,877	—	—	—	—	—
	Do. Northern Extn.	185	25.5.35	1,241	— 1,360	47	52,455	90,185	— 37,730	—	—	—	—	—
	Do. Western Extn.	211	25.5.35	602	— 725	47	35,225	72,912	— 37,687	—	—	—	—	—
	Cordoba Central	1,218	25.5.35	26,340	+ 670	47	1,315,980	1,528,100	— 212,120	Ord. Inc.	6	3	3	Nil
	Costa Rica	188	Mar., 1935	18,257	— 2,479	39	149,326	178,636	— 29,310	Stk.	30⅝	23½	32	6¼
	Dorada	70	Apl., 1935	10,700	+ 1,100	17	44,100	41,100	+ 3,000	1 Mt. Db.	103	95	104½	5⅝
	Entre Rios	810	25.5.35	10,124	+ 1,175	47	570,020	567,242	+ 2,778	Ord. Stk.	21½	12	12½	Nil
	Great Western of Brazil ..	1,082	25.5.35	5,500	— 400	21	186,000	179,300	+ 6,700	Ord. Sh.	⅞	⅝	½	Nil
	International of Cl. Amer.	794	Mar., 1935	$469,057	— $83,653	13	$1,307,612	$1,523,084	— $215,742	—	—	—	—	—
	Interoceanic of Mexico ..	—	—	—	—	—	—	—	—	1st Pref.	1/-	1/-	½	Nil
	La Guaira & Caracas ..	22⅝	Apl., 1935	4,960	+ 1,490	17	15,500	14,380	+ 1,120	Stk.	12⅝	7⅝	8½	Nil
	Leopoldina	1,918	25.5.35	17,653	+ 117	21	461,685	448,867	+ 12,818	Ord. Stk.	14⅝	7	5	Nil
	Mexican	483	21.5.35	$279,500	+ $55,200	20	$4,896,200	$4,669,700	+ $226,500	,,	3¼	1½	1½	Nil
	Midland of Uruguay ..	319	Apl., 1935	6,362	— 1,230	43	97,748	95,108	+ 2,640	,,	1½	½	1½	Nil
	Nitrate	401	15.5.35	5,439	— 267	19	55,133	64,521	— 9,388	Ord. Sh.	32/32	51/-	2¼	Nil
	Paraguay Central	274	25.5.35	$1,901,000	+ $872,000	47	$54,835,000	$34,827,000	+ $20,008,000	Pr. Li. Stk.	84	67	60½	9¹⁵/₁₆
	Peruvian Corporation ..	1,059	Apl., 1935	68,305	+ 18,338	43	625,461	556,896	+ 68,565	Pref.	14½	8	7½	Nil
	Salvador	100	18.5.35	¢18,975	+ ¢225	46	¢972,227	¢984,633	— ¢12,406	Pr. Li. Db.	75	70	65	7¹¹/₁₆
	San Paulo	1531/2	19.5.35	23,362	— 3,473	20	499,198	554,827	— 55,629	Ord. Stk.	86	67	57	4⅝
	Taltal	164	Apl., 1935	4,500	+ 2,875	43	31,385	24,072	+ 7,313	Ord. Sh.	2⅛	1⅞16	1⅝	7¼
	United of Havana	1,365	25.5.35	19,154	+ 3,865	47	1,097,844	907,579	+ 190,265	Ord. Stk.	6	2	2½	Nil
	Uruguay Northern	73	Apl., 1935	891	— 70	43	10,726	11,507	— 781	Deb. Stk.	6¼	3	4½	Nil
Canada.	Canadian National	23,735	21.5.35	629,884	— 45,593	20	12,369,779	12,180,392	+ 189,387	—	—	—	—	—
	Canadian Northern ..	—	—	—	—	—	—	—	— 4 p.c.	Perp. Dbs.	78¼	51½	59½	6⅝
	Grand Trunk	—	—	—	—	—	—	—	—	4 p.c. Gar.	104½	97¼	100⅛	3¹⁵/₁₆
	Canadian Pacific	17,211	21.5.35	439,800	— 31,400	20	8,608,000	8,781,200	— 173,200	Ord. Stk.	18⅝16	11¹¹/₁₆	11	Nil
India.†	Assam Bengal	1,329	10.5.35	31,410	— 7,035	5	129,435	162,077	— 32,642	Ord. Stk.	88½	72	83½	3⅝
	Barsi Light	202	30.4.35	3,450	— 870	4	12,052	12,967	— 915	Ord. Sh.	10½	9⅝	9⅝	5¼
	Bengal & North Western ..	2,113	10.5.35	80,300	— 4,151	5	302,279	322,342	— 20,063	Ord. Stk.	297½	262	296½	5⅜
	Bengal Dooars & Extension	161	30.4.35	2,847	— 859	4	9,154	9,975	— 821	,,	125¼	124	124½	5⅝
	Bengal-Nagpur	3,269	20.4.35	180,750	+ 8,038	3	354,450	337,761	+ 16,689	,,	105½	96	102½	3⅞
	Bombay, Baroda & Cl. India	3,072	20.5.35	254,550	+ 3,675	6	1,212,300	1,203,825	+ 8,475	,,	115	108½	114½	5¼
	Madras & South'n Mahratta	3,230	10.5.35	161,550	— 25,002	5	620,925	705,202	— 84,277	,,	131	122⅝	121⅛	7¹⁵/₁₆
	Rohilkund & Kumaon ..	572	10.5.35	15,148	— 2,198	5	64,919	71,551	— 6,632	,,	263	250	290½	5½
	South India	2,526	30.4.35	111,505	— 7,481	4	335,877	346,286	— 10,409	,,	119	115	117½	6¹³/₁₆
Various.	Beira-Umtali	204	Mar., 1935	73,647	+ 24,140	26	378,782	290,974	+ 87,808	—	—	—	—	—
	Bilbao River & Cantabrian	15	Apl., 1935	1,022	— 765	17	7,150	7,749	— 599	—	—	—	—	—
	Egyptian Delta	621	10.5.35	5,046	— 235	5	21,149	20,892	+ 257	Prf. Sh.	21⅜16	15¼	17⅝	5⅝
	Great Southern of Spain ..	104	18.5.35	1,927	— 325	20	37,964	43,908	— 5,944	Inc. Deb.	4	3½	3½	Nil
	Kenya & Uganda	1,625	Apr., 1935	222,462	+ 6,476	17	924,843	859,480	+ 65,363	—	—	—	—	—
	Manila	—	—	—	—	—	—	—	—	B. Deb.	50	33	44½	7⅞
	Mashonaland	913	Mar., 1935	118,527	+ 29,656	26	687,786	530,604	+ 157,182	1 Mg. Db.	101	91⅝	102½	4⅞
	Midland of W. Australia ..	277	Mar., 1935	12,005	— 1,495	39	122,226	122,214	+ 12	Inc. Deb.	100	93	96½	5⅝16
	Nigerian	1,905	13.4.35	31,550	+ 5,576	2	63,071	56,310	+ 6,761	—	—	—	—	—
	Rhodesia	1,538	Mar., 1935	206,064	+ 52,199	26	1,137,061	908,456	+ 228,605	4 p .. Db.	104⅞	97½	103½	3⅞
	South African	13,217	4.5.35	588,130	+ 98,078	5	2,686,331	2,366,770	+ 319,561	—	—	—	—	—
	Victorian	6,172	Jan., 1935	834,638	— 17,346	30	5,586,612	5,388,619	+ 197,993	—	—	—	—	—
	Zafra & Huel ..	112	Mar., 1935	11,058	— 362	13	32,962	34,675	— 1,713	—	—	—	—	—

NOTE.—Yields are based on the approximate current prices and are within a fraction of 1/16

† Receipts are calculated @ 1s. 6d. to the rupee. § ex dividend. Salvador and Paraguay Central receipts are in currency

The variation in Sterling value of the Argentine paper peso has lately been so great that the method of converting the sterling weekly receipts at the par rate of exchange has proved misleading, the amount being overestimated. The statements from July 1 onwards are based on the current rate of exchange and not on the par value

Electric Railway Traction

Running Experience with Electric Trains

ALTHOUGH suburban electrifications usually bring a substantial increase in revenue and traffic, and their propensities in this direction given full notice, little is said about the difficulties of operation and maintenance which may crop up in the first few months, even in systems which have nothing out of the ordinary in their equipment. A case in point is found on the 1,500-volt d.c. lines round Capetown, where constant watchfulness during the first few years was necessary in order to combat the effect of climatic conditions, and also to improve the design of details until they almost disappeared from the maintenance sheet. Full records have been kept of all the troubles encountered and the work necessary, and the compilation and analysis have proved of great value in running the stock successfully and preventing failures. One of the major troubles encountered in the beginning was the bad riding of the stock, and this gave rise to complaints from passengers and, in addition, caused defects in the pantographs, traction motors, and gears. These troubles were eliminated largely when the spring-centring device was removed from the motor-coach bogies. The excessive lateral movement caused bad meshing between the pinion and gear wheel teeth, and this led to endless trouble with slackening of the keep bolts of the motor-bearings and damage to the brasses; loosening of the gearcase bolts; and in certain cases to a slackening of the armature-bearing housings in the motor frame. The reduction of impact load on the teeth (thought to be caused by rough shunting) was considered to be of some importance for a number of pinions had to be discarded for this reason after an average mileage of only 103,000, and some gearwheels after a mileage of 185,000. To get over this difficulty the control system was modified to ensure that the driver brings the train to a standstill before applying reverse power, and the stock as a whole is now well behaved.

Making Up Lost Time

A FEATURE of the Paris-Orleans Railway main-line electrification has always been the consistent way in which arrears of time have been made up on the electrified lines from Vierzon and St. Pierre des Corps (Tours) to Paris, and apparently this propensity is to become a feature of the new conversion between Brive and Vierzon. Connecting trains at the Spanish frontier at Irun, Puigcerda, and Port Bou are often late, and although time may be gained on the ensuing steam sections it is not uncommon for international and through express trains to be 15 or 20 min. late when entering the electrified divisions. But it is no less uncommon for those same trains to be more than five minutes behind schedule when arriving in Paris, after having averaged 68 to 73 m.p.h. over the 144 miles from St. Pierre des Corps, or the 125 miles from Vierzon. With a train of 634 English tons, the 4,000 h.p. 2-Do-2 electric locomotive E.512 recently made up 33 min. on the former section, and covered the 144 miles at an average of 68 m.p.h. including the momentary stop at Les Aubrais. A sister machine, E.519, hauling 700 English tons, regained 10 min. between Les Aubrais and Paris (Austerlitz) by averaging 68·3 m.p.h. Over the Vierzon-Paris section similar enterprise is shown, and on Christmas Day last, E.525, with a trailing load of no less than 830 tons, made up 28 min., the 125 miles being covered in 109 min., including a six-minute stop at Les Aubrais. This gives an overall average of 69 m.p.h. and a running average of 72·9 m.p.h. despite the observation of the legal maximum of 75 m.p.h. Everyday feats such as these show with no uncertainty a benefit of electrification which is recognised immediately by the public, which passes back its appreciation in the form of increased revenue.

Traction Motor Gears

ONE of the vital elements of any installation of nose-suspended motors is the reduction gearing, and the comparatively little trouble that is experienced on many railways is a tribute alike to the design, material, manufacture and maintenance. As a rule, the life of both pinions and gearwheels is over half-a-million miles, but defective lubrication, incorrect alignment, or faulty material may play havoc with the performance and render the upkeep of the gears and motors a serious problem. The nickel-chrome steels now in general use for gears give satisfactory service, but no material will stand up to the stresses and impacts caused by bad meshing and insufficient lubrication. The most satisfactory lubricant is often, though not necessarily, that with the lowest consumption; one large organisation has given up recently the use of a lime-base grease of stiff consistency in favour of a highly viscous black residual oil, and has thereby increased the miles per lb. from 120 to 270 and at the same time has reduced to a considerable extent the previous troubles and noisy operation. This oil requires a weekly topping up of one lb. per gearcase per week in winter and half as much again in summer. With all lubricants it is essential that the two halves of the gearcase be fitted together tightly and some special type of insertion may be necessary. Incorrect alignment probably causes the majority of troubles, and it is certainly the most difficult fault to rectify. First class workmanship during the original erection may ensure a sufficient degree of accuracy to prevent trouble, but in more than one case the cause of bad alignment has been blamed on the provision of a single set of reduction gears, which is an inherent fault of the nose-suspended motor for standard and narrow gauges. Careful inspection of the gears during shopping may prevent serious failures on the road, and the inspection methods adopted on the Victorian Government Railways are described elsewhere in this issue.

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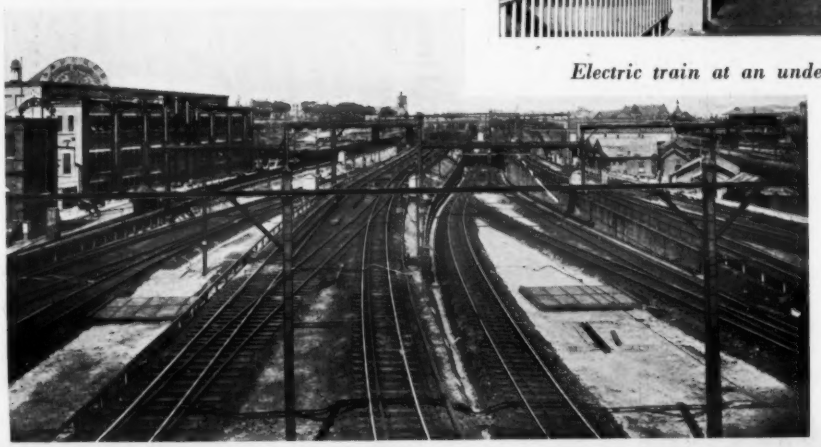
Above: The interior of one of the stations on the Sydney underground railway

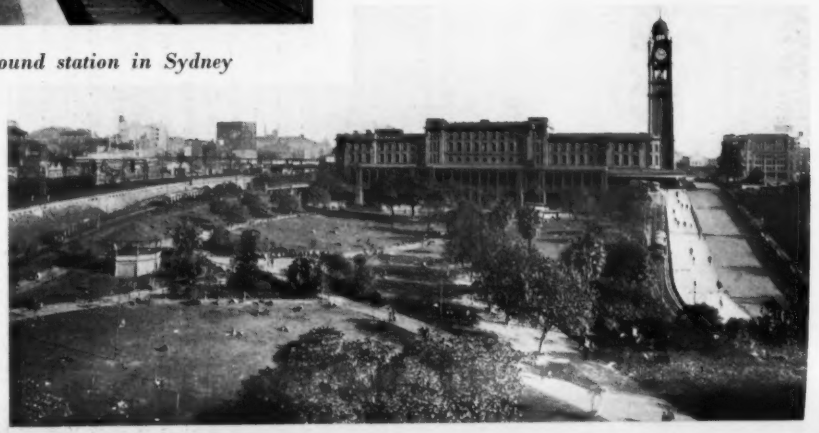
Above: Rolling stock sidings and fly-over junctions at Sydney

Electric train at an underground station in Sydney

Below: Fly-over junctions outside Sydney Central station. View looking from the station



Below: Sydney Central station with rail, tram and road approaches

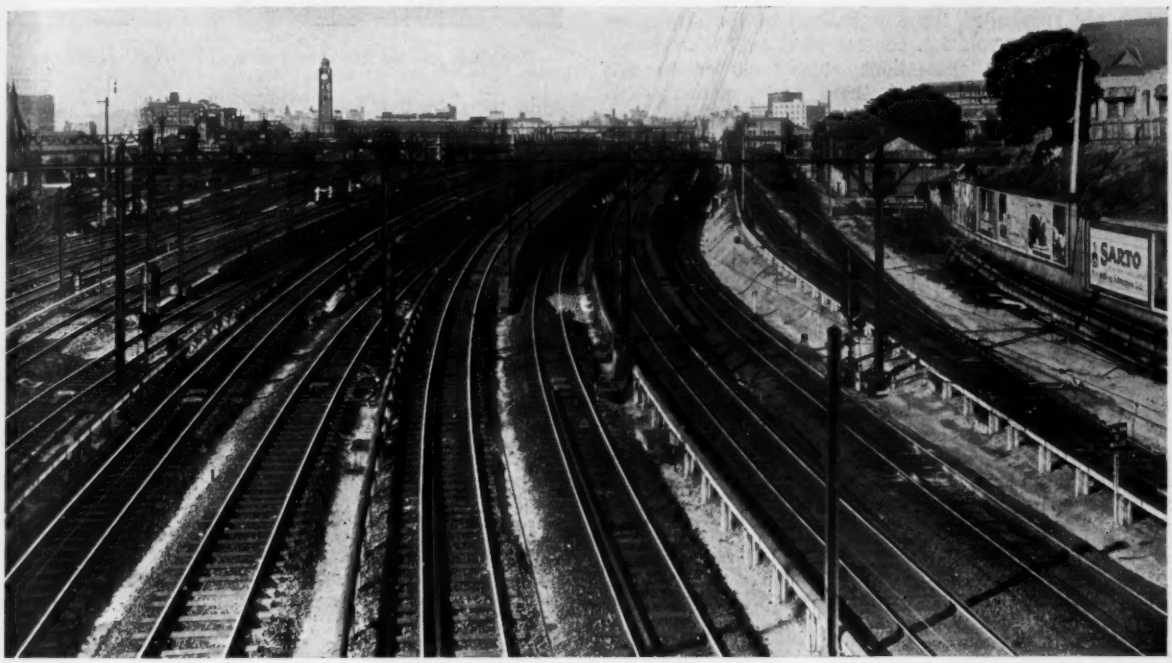


SUBURBAN ELECTRIC LINES AT SYDNEY, NEW SOUTH WALES GOVERNMENT RAILWAYS

SUBURBAN RAILWAY ELECTRIFICATION IN AUSTRALIA

By A. W. ARTHURTON, formerly Secretary, British Railways Press Bureau

THE conversion of the Melbourne suburban railway system from steam to electric traction was begun as far back as 1913 and was completed in April, 1923, delay having been caused by the war. The cost was approximately £6,000,000. Many improvements have resulted from electrification, which, with the advantages of greater mobility it confers, has permitted of additional convenience to the travelling public in that it is now possible, in the majority of cases, to make a journey between the northern and southern suburbs without changing trains. The electrified lines comprise about 173 route miles and 439 track miles, and extend from the central station at Flinders Street for varying distances, the longest being to Frankston, 26½ miles. In the scheme, 140 miles of 20 kV. feeder cables had to be laid underground and 146 miles of overhead high tension transmission lines erected.



Approach to Sydney Central station showing fly-over junctions and yard. The tower in the distance is part of the station buildings

The multiple-unit trains which operate the services are composed of sliding-door and swing-door cars, but all new cars are being built with the former type, this having been found the more suitable. Each unit consists of a motor-coach and a trailer, and a normal train at busy periods is composed of three of these units, strengthened on some lines by an additional trailer coach. During the slack periods of the day the trains are reduced to either two or four coaches. Motor coaches are second class and trailers first class. A seven-car standard train seats 324 first, and 304 second class passengers, but peak loads of nearly double that number can be carried.

Each motor coach is fitted with four motors of 140 h.p. continuous capacity, driving the wheels through single reduction gearing having a ratio of 3·2 to 1. The motors are of the fan-ventilated type. Each motor coach has one pantograph, a dynamotor supplying control and lighting current, a motor-driven air compressor, and the necessary control gear. An automatic trip gear is fitted which engages with an arm at the side of the track should the motorman attempt to pass a signal at danger; if operated, this cuts off power and applies the brakes. The control is of the G.E. all-electric type, and gives six series steps, and six steps with two pairs of motors in parallel. The master-controller is fitted with a dead-man handle.

Electric parcels coaches, running to fast schedules, now transport practically the whole of the parcels traffic between Melbourne and suburban stations, and handle the traffic with great expedition. Apart from these definite advantages to railway customers, important operating benefits are secured by the reduction in the duration of the stops of suburban passenger trains at stations by comparison with the time required when the trains were carrying parcels. This factor alone has enabled radical improvements to be made in the timekeeping of suburban trains.

The busiest passenger station in Victoria is Flinders Street, Melbourne, where 16 platforms are in constant use, the total face length of the platforms being 1¾ miles. Approximately 2,070 electric trains (and 122 steam) pass through or leave this station each day. According to a tally taken in February, 1934, the daily average number of passengers passing through the barriers was 282,426, this comparing with 210,273 in 1914. Fifty-two trains are required to operate the suburban service from this terminal

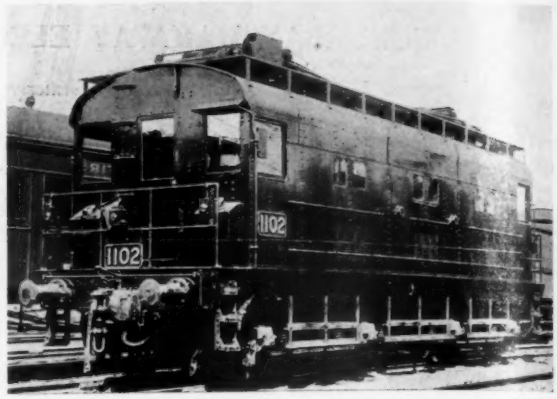
XUM

during the slack periods of the day. Forty-one additional trains are brought into use for the morning peak period, which extends from 7.30 a.m. to 9 a.m., and forty-seven additional trains for the evening peak from 4.30 p.m. to 6.30 p.m.

Current for the electric lines is generated at the Newport power house, about six miles from Melbourne. The plant has an installed capacity of 78,000 kW. at 0·95 power factor. There are six turbo-alternators, four of which have a continuous capacity of 12,500 kW. each and two of 14,000 kW. each. The power generated is three-phase 25 cycles at 3,300 volts, and each alternator is directly connected to a step-up transformer which raises the pressure to 20,000 volts. Power is distributed by underground cables to the substations of the inner suburban area. Beyond this limit overhead transmission is used, and conductors are suspended from extensions of the structures carrying the 1,500-volt d.c. contact wires over the railway tracks. Twenty-one substations supply power to the electrified system. Four of these have mercury arc rectifier plant installed and the remainder are equipped with rotary converters for supplying the contact wires. The largest substation is that at Jolimont, about a mile from Flinders Street station. This contains four larger converters of 4,500 kW. continuous capacity. In 12 of the smaller substations the equipment is entirely automatic. A depot for the maintenance and repair of overhead equipment is centrally located near Flinders Street station, and is equipped with fast motor wagons fitted with the necessary gear for the rapid repair of overhead faults.

N.S.W. Electrification

Sydney, the capital and commercial centre of New South Wales, contains the only underground railway in Australia, The City Railway, as it is called, is the heart of a far-flung system of electric railways serving the northern, eastern, southern and western closely-settled suburbs. The railways provide the principal means of transport between the suburbs and the city, and for the purpose of railway working the surrounding country lying within 34 miles of Sydney is considered as being

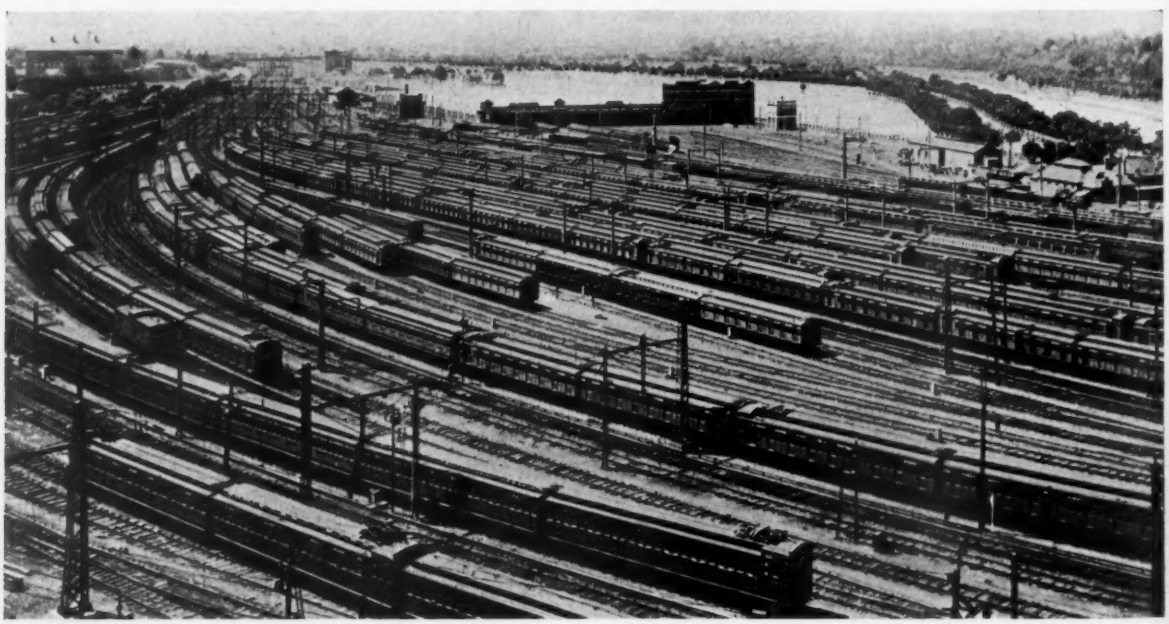


Double-bogie electric locomotive, Victorian Railways

within the suburban area. Within this boundary are 185 route miles of railway, with electric operation to approximately 20 miles from the city, and steam operation for the outer area.

Until the electrification of the suburban railways was undertaken, all railway services commenced and terminated at Sydney Central station, which, despite its name, is well outside the centre of the city. For more than 70 years previously representations had been made to successive Governments regarding the desirability of extending the railway system into or through the city. As far back as the year 1909 a Royal Commission appointed to consider the matter found that the transport problem of Sydney had reached such an acute stage that it had become imperative to construct through the city a railway to be operated electrically, and to electrify the whole of the existing suburban lines. Although it recommended that the work be put in hand without delay it was not until 1926 that the underground railway was completed and the suburban lines electrified.

Parliament having approved the building of a bridge across the harbour in preference to a tunnel underneath,



Broad-gauge suburban electric stock in the sidings at Melbourne

Electric parcels motor-coach as used on the Sydney electrified system of the New South Wales Government Railways

the City railway was constructed partly underground and partly on viaduct. As the State owned both the railways and the tramways, it was possible to devise a scheme enabling trains to be run between the suburbs and the business area of the city through Central station. Here there are eight run-through platforms for electric trains; the electric tracks do not cross on the same level as the steam lines but by fly-overs outside the station. There are four stations on the underground railway, viz., Wynyard, Town Hall, St. James, and Museum. The line will eventually form an "Inner Circle," but the present terminus is at St. James station. Thence it will run under the Botanic Gardens and emerge at Circular Quay, where the still huge ferry traffic is dealt with. Here there will be a Quay station to take the place of the present tramway terminus, and the line will then sweep round to complete the circle by joining the direct line from Central station over the Harbour bridge. At Wynyard station, through which approach by train and tram to the Harbour bridge and North Sydney is made, there are high and low level platforms.

The system of electricity used at Sydney is 1,500 volts d.c., with overhead conductor, which the experience of Melbourne had shown could be constructed and maintained economically. The trains are of the multiple-unit type and consist of two sets of four-car coupled units during the rush hours, reducible to a single four-car unit, and in a few cases to two cars during slack periods. The trains are mostly of all-steel construction. The average speed, including stops, varies from 20 to 25 m.p.h., the maximum allowable speed being 50 m.p.h. Normal acceleration is 1·25 m.p.h.p.s. and normal braking 1·75 m.p.h.p.s. as a maximum.

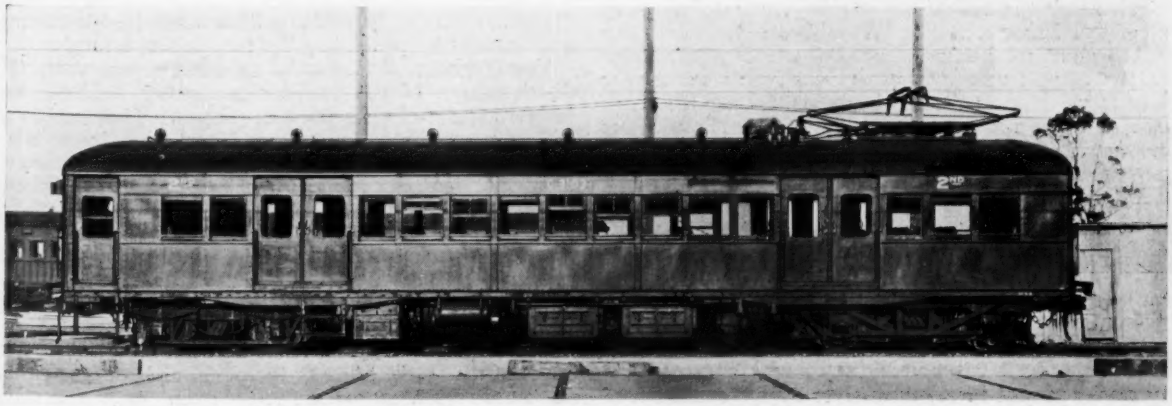
Although the suburban area extends to all points 34 miles distant from Sydney Central, the bulk of the travel is to and from the nearer suburbs, the average distance travelled per passenger being 7·22 miles. Average stations this distance from Central station, as shown below, indicate the frequency of service during the peak hours:—

Illawarra section ..	Kogarah station	13	stopping	trains	per hr.
Bankstown line ..	Campsie ,,	16	,,	,,	,,
Main suburban line ..	Burwood ,,	19	,,	,,	,,
North Shore line ..	Lindfield ,,	15	,,	,,	,,

The average distance apart of stations in the busier sections is 64 chains, and a service stopping at all stations is given. In peak hours a fast non-stop service is given to more distant stations. From Wynyard station between 5 and 6 p.m. every weekday, 67 electric trains leave for the North Shore side and from St. James 32 leave for the southern suburbs. Throughout the whole of the electrified area automatic signalling is installed. The signals are of the searchlight type, giving three indications: two reds = danger (stop); red and green = caution (slow); two greens = clear. Working in conjunction with these signals are train stops which, in the event of the signal being passed at danger, immediately stop the train.

The basis of the second class ordinary fares in the suburban area is 1d. per mile up to 9 miles, and ¾d. per mile thereafter. Weekly, periodical and workmen's tickets are fixed at cheaper rates. The public demand a high standard of travel at the lowest cost, and the average fare received per passenger mile only amounts to 0·58d.

There are no other cities in Australia with a suburban traffic which would justify the expense of electrifying existing lines, but the experience of both Melbourne and Sydney, where huge suburban populations exist, has shown that fast and frequent services of electric trains reduce traffic congestion, minimise the time spent in daily travel, and facilitate transit not only between suburb and city but also between widely separated suburbs.



720 h.p. suburban motor-coach, New South Wales Government Railways

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CRACK DETECTION IN TRACTION MOTOR GEARS

The application of the magnetic method to steel pinions

FOR the detection in such parts as axles, wheels, and pinions, of minute cracks which would lead ultimately to failure of these constituents, the Victorian Government Railways have adopted the magnetic method of examination during the general inspection of the parts concerned at Jolimont workshops. A useful article on this subject has been published in *The Commonwealth Engineer* from the pen of Mr. H. D. Manton, and, by the courtesy of the Editor of that journal and of Mr. H. P. Colwell, Chief Electrical Engineer of the Victorian Government Railways, we reproduce this herewith.

The characteristics of steel are such that, while outwardly a portion of machinery may appear sound, minute cracks, often invisible to the naked eye, may exist, and these impose a far greater strain on the remaining sound material than it was designed to withstand. The result often is a complete and costly fracture. which might have been avoided if the existence of the original crack had been known and the part withdrawn from service. Very often, also, the discovery of incipient cracks makes it possible to improve a steel part from the design standpoint, since defects in design are a most prolific source of fatigue failures.

Methods of Examination

Various methods have been evolved to deal with the trouble by means of the systematic examination of parts usually subject to failures, and some of these are as follow:—

Cleaning and Heating.—All surface grease is first cleaned from the part to be inspected. Heat is then applied and any cracks present reveal themselves by the exudation of the oil lying in them. This is a comparatively simple process, but it has the disadvantage that, even although the heating may be of small extent, it is liable to distort and alter the temper of the part in question.

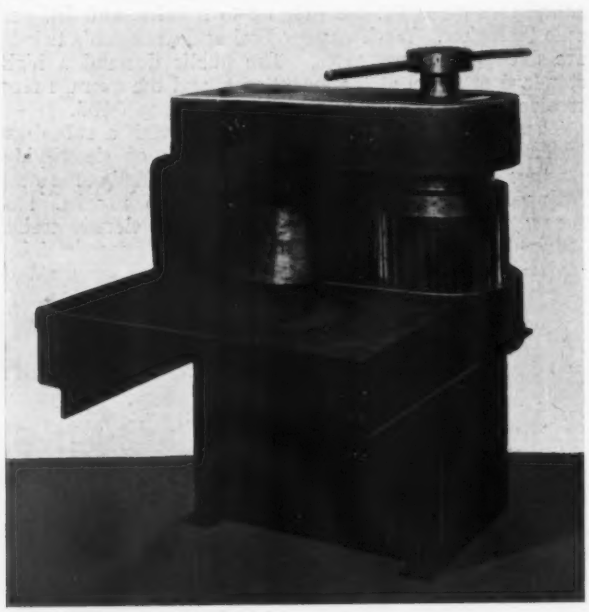


Fig. 1—Magnetiser for traction motor pinions as used on the Victorian Government Railways

Ringing.—The common method of ringing the metal is frequently resorted to, but is unreliable even to a practised ear. Often parts will give a sharp ring when seriously cracked, due to the direction of the crack corresponding to the line of acoustic vibration of the part and failing to break either the fundamental or prominent harmonics.

Oil and Whitewash.—This is a variation of the cleaning and heating method. The part is first immersed in kerosene or oil and the surface to be inspected is carefully cleaned. Whitewash then applied is allowed to dry, and any cracks betray their presence by the subsequent discoloration of the whitewash through exudation of the oil or kerosene. Although this method is used extensively, it is subject to the disadvantage that it is difficult to apply the whitewash evenly, and any thick layers tend to obscure small cracks by preventing the oil working through.

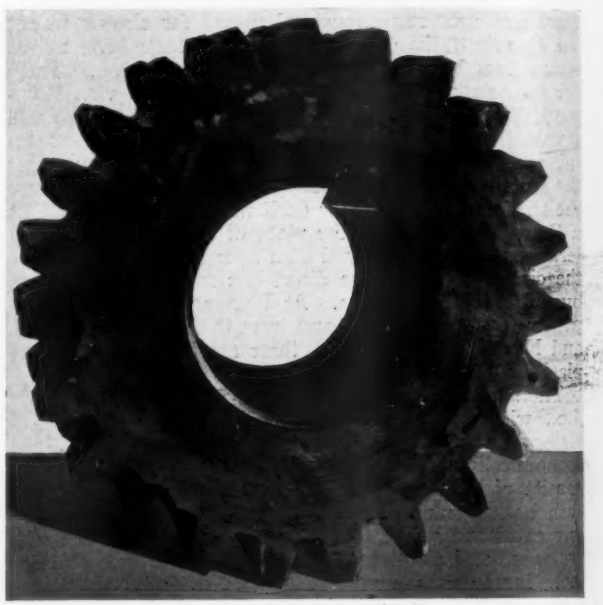


Fig. 2—Traction motor pinion before magnetisation

The Magnetic Method.—As an effort to overcome the disadvantages of the methods previously outlined, the magnetic principle has been developed. This consists of highly magnetising the part and searching by suitable means for the extraneous field set up by the presence of a crack. The part is so magnetised that lines of force are caused to flow through the crack, which breaks them and causes them to emerge on the surface of the steel. It only remains to apply suitable means of detecting the presence of the external magnetic field to display the crack causing it. This is usually carried out by applying to this part a solution or powder containing iron particles in a finely divided form. The iron filings adhere to the edges of the crack, bridging the poles, and showing easily the outline upon the surface of the steel. After inspection the part is demagnetised.

A complete equipment for utilising this principle must

provide for:—(1) magnetism of the part or parts; (2) immersion or other application of the detecting fluid or powder; (3) inspection; (4) demagnetisation.

Magnetisation.—In cases where it is desired to inspect steel parts made from material with a high degree of magnetic retentivity, the part may be magnetised previously to treatment, as the residual magnetism is sufficient to show up any cracks. When this cannot be done owing to the low residual magnetism of the material, or to the unsuitable shape of the object, the equipment may be designed to maintain the magnetic flux during treatment and inspection. These considerations largely determine the size and shape of the magnetiser, which may vary considerably owing to the necessity for the part under test forming a portion of the magnetic circuit.

It is obvious that some care must be taken with the degree of magnetism which is imparted to the steel. If the steel is over-saturated there will be a certain amount

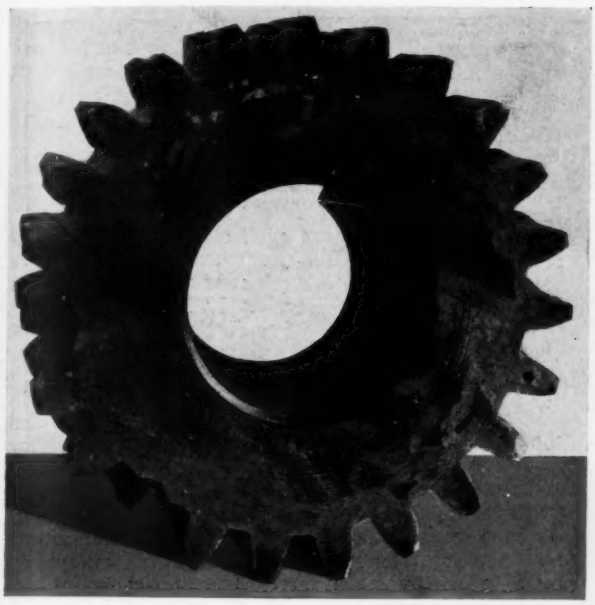


Fig. 3—Traction motor pinion after magnetisation

of external magnetism which is crowded out of the metal and this may lead to false readings. If, on the other hand, the steel is insufficiently magnetised, it follows that the lines of force broken by the crack will merely revert to the remaining sound portion of the metal and fail to give the required external field. The correct degree of magnetism is largely a matter of experiment, and is obtained by suitable regulation of the electro-magnetic method used.

Application of Detecting Fluid.—The detection of the cracks may be carried out either by dusting with iron powder or by immersion in or blasting with a paraffin solution containing iron particles in suspension. In either case the iron particles used should be of very low carbon content and of a high permeability. This is usually obtained by the production of a pure iron free from carbon and oxides by reduction in hydrogen. It is considered that the most satisfactory method of application is by using the solution, as exposure to air of the iron powder tends to produce an iron oxide which is useless for magnetic purposes. When immersion tanks are used it is necessary to instal either a motor-driven stirring device or to stir the solution vigorously by hand before use, since the iron particles settle to the bottom of the container in a few seconds. After immersion in the tank for a few minutes, the part under test is removed and allowed to drain.

Inspection.—This is normally a simple procedure, since the method enables cracks to be clearly seen with the naked eye, but in cases where the surface to be inspected is of unsuitable shape, *e.g.*, the bore of a large forging, it is often necessary to use additional equipment, such as a telescope with lamps and mirrors.

Demagnetisation.—Since it is obviously undesirable to leave parts subject to wear in a magnetised state, demagnetisation is usually carried out. This may be effected either by subjecting the part to a diminishing a.c. field or,

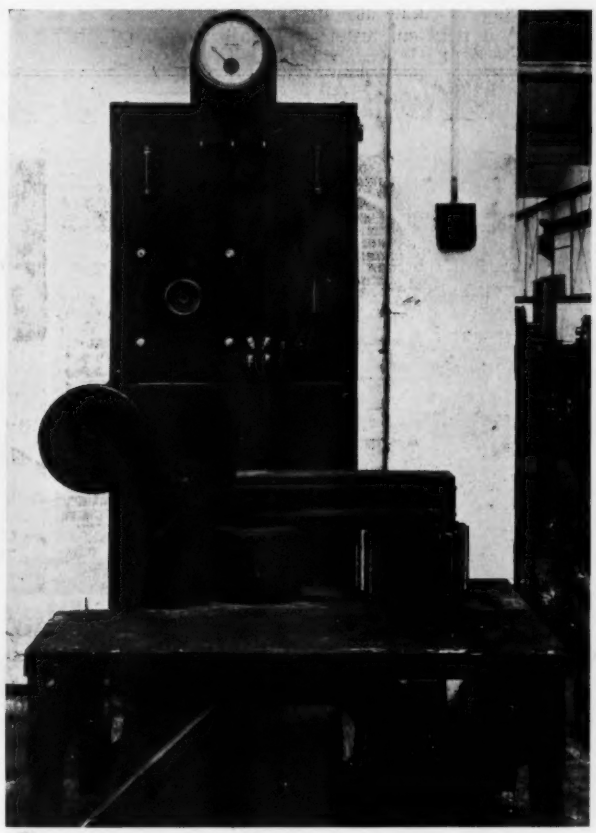


Fig. 4—Demagnetising equipment for pinions and small parts, Jolimont shops, Victorian Government Railways

in cases where this is impracticable, by a reversal, or a number of reversals, of the direct current flux.

Application to Railway Pinions

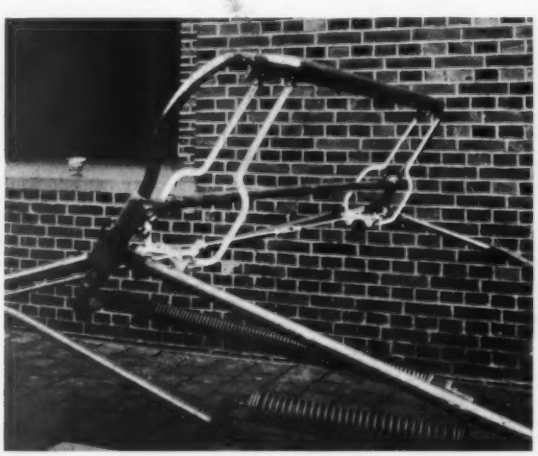
With the object of utilising the foregoing principles, which are well known and have been used successfully for many years in England and the U.S.A., the Victorian Railways has designed an equipment for the detection of flaws in the pinions of electric traction motors. As will be seen from Fig. 1, the magnetiser consists of a compact magnetic circuit, which is completed by the insertion of the pinion. The magnet coil is excited from a 750-volt d.c. circuit, and the residual magnetism is utilised for crack detection. This is carried out by immersing the pinion in a small circular tank containing a solution of kerosene and iron particles produced from oxide by the reduction process. In order to keep the fluid free from impurities, which might settle on the surfaces to be inspected and thus render more difficult the work of

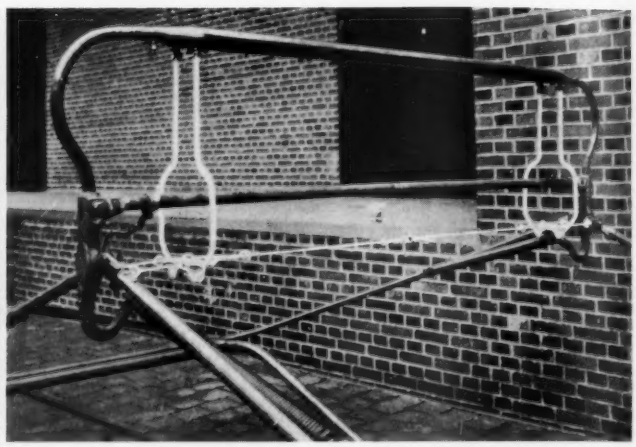
detection, it has been found essential to clean the pinions thoroughly from all grease, filings, and foreign matter before treatment. Also, as the side surfaces of the pinions had been originally somewhat roughly machined, with the tool marks still showing after a number of years' service, it was found advantageous to grind these surfaces to a bright finish in order to render more visible any cracks shown up by the method of test. This is conveniently carried out by means of a small portable grinder, and involves only a few minutes work on each pinion. Fig. 2 and 3 show a pinion before and after immersion and indicate the high degree of crack visibility with the method.

In order to make use of existing equipment as far as possible, a field coil tester consisting of a laminated iron circuit excited from an a.c. source is used for the purpose of demagnetisation. The pinion is placed in the iron circuit, as shown in Fig. 4, and the a.c. flux is gradually reduced to a sufficiently low value, first by means of suitable tappings on the exciting coil, and finally by means of a rheostat.

This equipment has been in use at Jolimont for 18 months, and is proving its usefulness not only in regard to testing pinions, but also for testing small steel parts of railcars during periodic inspections. The detecting fluid now in use consists of a mixture of kerosene and waste iron particles produced from a grinding machine. This is considerably cheaper than using iron produced by the reduction process, and is quite satisfactory for general purposes.

A New Type of Pantograph Shoe Holder

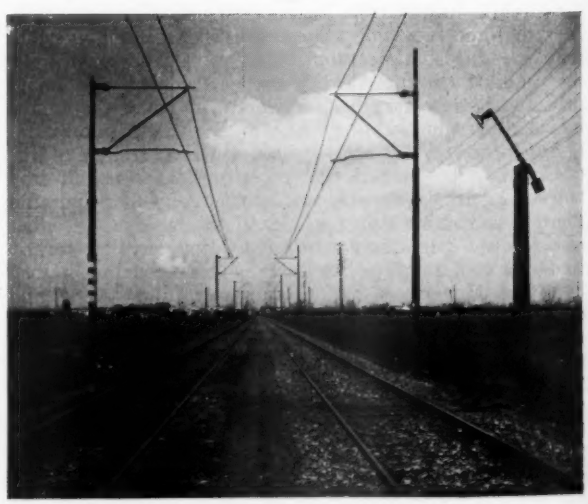




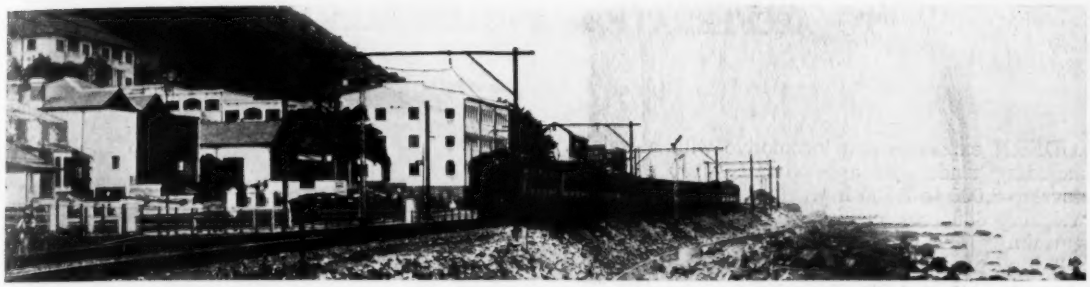
A modification to the collecting mechanism of small pantographs has been devised by Mr. K. Eifert, a former rolling stock engineer of the Berlin Transport Company, and is now in use on the vehicles of that organisation working over the eight-mile line from Spandau West to Hennigsdorf. The arrangement consists of four levers, two at each end of the contact plate as shown in the accompanying illustrations. The lower end of each lever is attached to bearings carried by an adjustable steel wire extending transversely between the top bearings of the tubular frame of the pantograph. This bearing can move in a vertical direction only, but the arrangement of levers ensures that the contact strip will always be parallel to the overhead wire. The application of the Eifert holding device means that the pan can be pressed against the wire with a lower pressure, and service results show some diminution in the rate of wear of both contact strip and wire and less interference with wireless sets.

Electrification of Italian Private Railway

The North Milan Railway, has decided to electrify its whole system. At the moment only the lines from Milan to Meda, 12 miles, and from Milan to Saronno, 13½ miles, are electrified, the system being 3,000 volts d.c. The total route length of the North Milan Railway is 164 miles. The lines are standard gauge, and carry a heavy passenger traffic which amounted in 1933 to 434,000,000 passenger-km; goods traffic for the same year was 19,250,000 tonne-km.; the operating ratio was 0·78. Kilometre receipts on the main line from Milan to Bovisa and Saronno amounted to £12,000. The whole railway is mainly a passenger line, and the passenger receipts for 1933 represented 72 per cent. of the total. A section of the North Milan Railway has been fitted up with the Kofler mechanical train-stop apparatus, and one of the lineside standards for this device is shown in the accompanying illustration. The mast on the left-hand side is painted with white rings to indicate the approach to a signal.



RUNNING EXPERIENCES ON A D.C. SUBURBAN SYSTEM



Eight-coach electric train on the Cape Town suburban service

USEFUL information regarding the operation of the Cape Town suburban electrified system of the South African Railways is given in a paper entitled "Experience and Conclusions of the Running of the Cape Town to Simonstown Electrification of the South African Railways," by Mr. J. H. Sprawson, which is published in the journal of the Institution of Electrical Engineers for May. The Cape Town suburban system was described in the issue of this Supplement for February 9, 1934. The service was inaugurated in June, 1928. The average headway during the morning and evening peak is 2½ min., and at midday 3 min.; during the slack hours there is a 10-min. service and on Sundays 20 min. The 22½ route miles and 26 stations are worked by 19 train sets which maintain a total daily service of 301 trains, carrying 74,000 passengers.

The total energy consumption for March, 1933, was 2,588,376 kWh., representing 20·935 kWh. per train-mile, 12·72 kWh. per motor-coach mile, and 93·5 watt-hours per ton-mile. The consumption of energy is measured on the high-tension alternating-current side of the converting plant in the substations, and therefore the mean efficiency of conversion and distribution to trains should be estimated at 85 per cent. This calculation brings the consumption of 93·5 watt-hours per ton-mile measured on the a.c. side to 79·5 watt-hours per ton-mile measured on the d.c. side.

Trouble was experienced with pantographs after the first year of service, caused through the excessive side sway and rocking movement of the coaches, which imparted whip and shock to the pantograph superstructures. Excessive strain was thrown on the brazed joints between the tubes and their sockets, resulting in broken joints and the breaking of the tubes where they enter the sockets.

The sockets on the main shaft, which form the anchorage of the moving structure, were the greatest source of trouble in this respect. It was also found, during investigation, that the brazing on many of the sockets had only taken round the outer edge of the joint, instead of running well into the casting, thus causing a further weakness at these points. The trouble with broken tubes was overcome by reinforcing the sockets on the main shafts. Lengths of steel tube, turned to a neat fit, were driven into the panel tube, and then riveted in place, both through the socket and through the panel tube itself. This modification was effected on all pantographs and no further trouble was experienced with tubes breaking at these points.

Contact strips, with a chamfered outside edge, did not prove satisfactory, owing to the burning of the trays along the exposed edge, through arcing. This trouble was eliminated by the introduction of the type of strip which follows the radius of the tray round, projecting down below the top surface, thus protecting it from the arc.

After the first year of service it was noticed that abnormal rusting and pitting was taking place on the collector trays, particularly over the contact area of the strips. From the state of deterioration it appeared that electrolytic action was taking place through the interposition of moisture with other impurities between the strips and the tray. This condition was overcome by the use of modified stripping and by protecting the surface of the tray with an insulating paint.

A motor-coach is equipped with four axle-hung motors, two being mounted on each bogie, and transmitting power to the wheels through the usual type of spur gearing. The output of a motor at the one-hour rating is 187 h.p. at 225 amp. 700 volts, and provision is made for field tapping. The motors are connected in pairs, the two motors of a pair being permanently in series.

The motors are self-ventilated by a fan on the armatures. This method of air circulation has not proved entirely satisfactory, owing to the large amount of dirt and dust drawn into the motors and deposited round and about the windings and brushgear, and which chokes the ventilating ducts through the armature core. This has resulted in a great deal of trouble with brushes, insulation, breakdowns, and flash-overs. To combat this dust nuisance, excessive maintenance work has to be constantly carried out.

When motors are so situated that they draw in the track dust and dirt which is stirred up by the passing train, enclosed ventilation is preferable. This may take the form of forced ventilation or a type of pipe ventilation, but in either case the air-supply ingress must be so situated as to reduce the amount of dust drawn in, or some form of air filter must be employed.

Metallic dust and moisture have been responsible for the majority of armature failures. Through expansion and contraction and centrifugal strain, the original binders slackened badly, and the moist saline atmosphere along the coastal sections penetrated the tinning, causing rust and corrosion of the steel binding wire. The metallic dust has been especially harmful, working its way into the minute cracks and crevices and resulting in ultimate breakdowns on various occasions. To overcome this, as far as possible, a thorough and rigid programme of maintenance has had to be adhered to. This includes re-banding, using a heavier-gauge wire and giving special attention to the canvas hoods, which go a long way towards protecting the windings; some assistance is also derived from the dipping of the armatures in varnish and baking, which is effected every 100,000 to 150,000 miles. It may be mentioned that some brands of varnish used have not given satisfactory results. This particularly applies to golden varnishes. Commutation has been satisfactory, the average wear being 0·006 in. per 100,000 miles.

XUM

THE ADVANTAGES OF RAILWAY ELECTRIFICATION WITH REGARD TO ACCELERATION AND DECELERATION

(From a Correspondent)

A MODERN express steam locomotive with a weight, including tender, of approximately 150 tons will develop 2,000 to 2,200 h.p. It will haul an express train weighing 550 tons making a total of 700 tons of moving train. The engine therefore develops approximately 3 h.p. per ton or just one tenth of the motive power provided for in some road motor cars. The relatively low resistance which a steam locomotive has to overcome at steady speed with its 3 h.p. per ton weight of train on good rail track enables it to reach a speed not widely differing from the balancing speed of the light road vehicle when travelling on a well surfaced road. During acceleration, however, the advantage definitely lies with the light vehicle with its relatively powerful engine.

High acceleration is not necessary for long distance non-stop express trains. It is, on the other hand, very necessary for suburban train services when the distances between station stops are relatively small. In order to obtain a reasonable schedule speed for such a service, not only must the initial or starting acceleration be reasonably great, but it must not fall away too quickly as the speed rises; at least, until a sufficient speed has been reached to enable power to be shut off and the train to coast and be braked to rest within the required time.

The acceleration is directly proportional to the tractive effort or torque available at the moment for accelerating the train after making allowance for the tractive effort necessary to overcome train resistance at the speed at the moment. The power required is proportional to the product of the torque or tractive effort and the speed, so that for any given applied h.p. the tractive effort falls away proportionately as the speed rises. To obtain a sustained high acceleration a large h.p. per ton of moving weight must be rendered available.

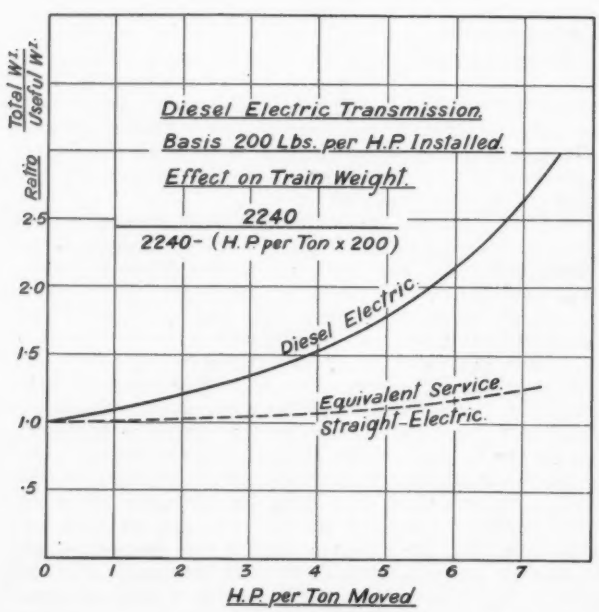


Fig. 1—Useful weight and power-weight ratios

On a scale applicable to normal railway trains it is not economical to provide self-contained power units on the trains capable of developing a large amount of power per ton of train weight. The weight of the power units adds too much to the weight of the train. To increase the available h.p. per ton, additional weight has to be carried which in turn increases the total h.p. necessary. Thus a vicious circle is created. There is not a great deal of difference between the weight per h.p. of a steam tractor and a diesel-electric tractor or diesel-electric mobile power house including the motors, &c., located throughout the train. Generally speaking, for plants which might be considered suitable for application to suburban services about 200 lb. per h.p. would be a fair average figure to allocate to the useful train as additional weight.

Power-weight Ratios

Mr. H. W. H. Richards in his paper* read before the Institution of Civil Engineers, February 21, 1933, indicates that 6 h.p. per ton is required from a diesel-electric prime mover to ensure the kind of suburban service required for London area, and there is every evidence that this figure is approximately correct. Accepting the figure of 200 lb. per h.p. as additional weight necessitated for the plant and carrying of same, it is found that 1,200 lb. in every ton is required, which leaves 1,040 lb. of useful loaded passenger coach in every gross ton of train. In other words the total weight of the equipped train would be $\frac{2240}{1040} = 2{\cdot}15$ times the weight of a normal trailing train.

The curve in Fig. 1 shows very clearly how quickly the above ratio increases with the increase in h.p. per ton that is required for speeded up suburban services; Fig. 2 gives an indication of the necessary h.p. per ton for providing such services. Mr. Richards, in his paper, shows that the diesel engine is normally called upon to give power for about 30 per cent. of the total time occupied in travelling between stations plus the time of the station stop. This clearly illustrates the poor load factor under which a power unit carried on a train must work, and accounts for the high capital cost of providing power units much in excess of the average demand. Clearly from this point of view alone there exists a very considerable advantage in having a centralised power plant capable of supplying trains over a large section of railway.

For a large number of trains the maximum power demands of the individual trains will not coincide and the result will be not a summation of the maximum power requirements of all the trains operating, but will approximate to the average power taken by the trains plus, of course, the losses in getting the power to the trains.

When electric traction is adopted the electric equipment of ordinary bogie stock for multiple-unit suburban trains weighs very much less than the corresponding diesel-electric equipment. The dotted curve in Fig. 1, below the diesel-electric curve, indicates the weight ratios to be expected for electrically equipped stock after making allowance for the heavier bogie trucks necessary to carry

* Primary Considerations Relating to Steam, Electric and Diesel-Electric Traction.

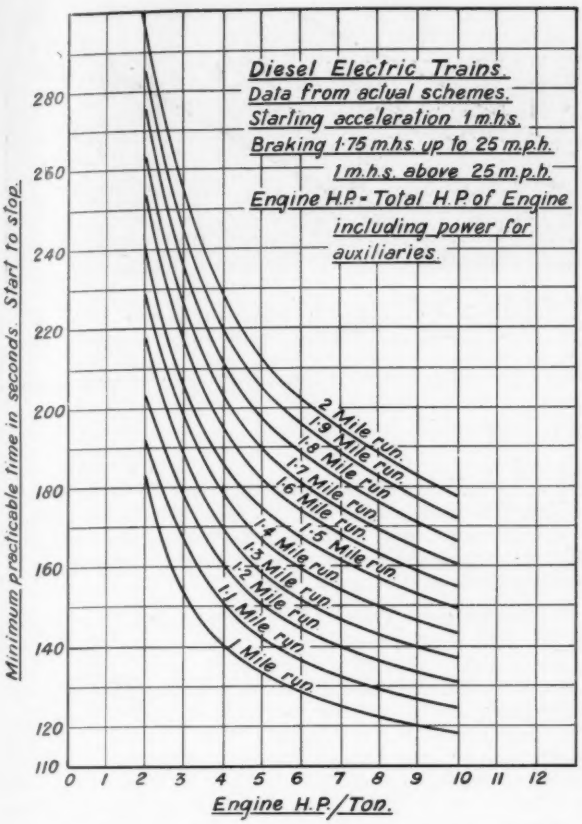

Diesel Electric Trains.
Data from actual schemes.
Starting acceleration 1 m.h.s.
Braking 1·75 m.h.s. up to 25 m.p.h.
1 m.h.s. above 25 m.p.h.
Engine H.P. - Total H.P. of Engine including power for auxiliaries.
2 Mile run.
1·9 Mile run.
1·8 Mile run.
1·7 Mile run.
1·6 Mile run.
1·5 Mile run.
1·4 Mile run.
1·3 Mile run.
1·2 Mile run.
1·1 Mile run.
1 Mile run.
Minimum practicable time in seconds. Start to stop.
Engine H.P./Ton.

Fig. 2—Required power-weight ratios for different schedules

the motors and some strengthening of the underframe on which to hang the equipment. The basis of h.p. per ton in this case is the one-hour rated basis, and as with ventilated motor equipments 7 h.p. per ton is approximately a maximum value it will be seen that the weight ratio does not exceed 1·25.

The advantage of minimising the weight of trains and taking power from a central source of supply instead of providing for self-generated power on the train produced by generating sets working with a very low load factor would seem self evident. In addition, allowance must be made for the reduced maintenance charges—both electrical and mechanical—which the electric alternative renders possible. Wear and tear on the track and the brakes are greatly reduced when the weight ratios drawn in Fig. 1 are kept to a minimum value. A further point which may in the future be of considerable importance is the possibility of braking the electric train by regeneration of power, thus relieving the power consumption by some 25 per cent. and also reducing the voltage drop on the collector system as the regenerating trains act as moving power houses to the motoring trains, and the distance of this transmission is small, so that the general level of voltage is held up on the whole section employing regeneration.

Increased Acceleration and Deceleration

The shorter the distance between station stops the more arduous it is to maintain a high schedule speed. The only thing to do is to increase the acceleration to as high a value as possible consistent with maintaining adhesion between driving wheels and rails and avoiding slipping of the wheels. The braking rate must be similarly increased. Take, for example, an average distance of 0·5 miles between station stops. Fig. 3 shows how an alteration in the acceleration will affect the average speeds in this case. A uniform acceleration of 1 m.p.h. p.s. up to 40 m.p.h. and a braking rate of 1½ m.p.h. p.s. will accomplish the half-mile run in 78 sec., or 23 m.p.h. average speed. The peak of power demand is equivalent to 12½ h.p. per ton exerted at the wheels.

If the accelerating and braking rates are both increased to 2 m.p.h. p.s. the run can be accomplished in 62 sec., or 29 m.p.h. average speed. The peak of power in this case is 24½ h.p. per ton. If the rate of acceleration were maintained to 60 m.p.h., an average speed of 30 m.p.h. would result, the peak of power becoming 36½ h.p. per ton. An intermediate result could be accomplished by a more uniform application of power, allowing an acceleration of 2 m.p.h. p.s. up to, say, 20 m.p.h. (=12½ h.p. per ton) and reducing the acceleration, as the speed increases while maintaining the power constant. The point to be noted, however, is that for short distances between stops a maximum of 10 h.p. per ton or more is necessary for good average speeds. The electric motor is admirably suited for this class of service which requires overloads for short periods followed by periods of no load. It is capable of great overload when required and draws its power from a relatively unlimited source of power without upsetting the load factor on that source of power.

Another point to be noticed in the figure is the great amount of kinetic energy stored in the train which has to be dissipated in the brakes. Taking some intermediate average speed such as suggested by commencing with 2 m.p.h. p.s. and easing this off to prevent the maximum power rising above say 12 h.p. per ton an average of 27 m.p.h. may be obtained, but braking would still have to be effected from 40 m.p.h. The stored energy at 40 m.p.h. is $\frac{40^2 \times 103}{3{,}600} = 45$ watt-hours per ton or

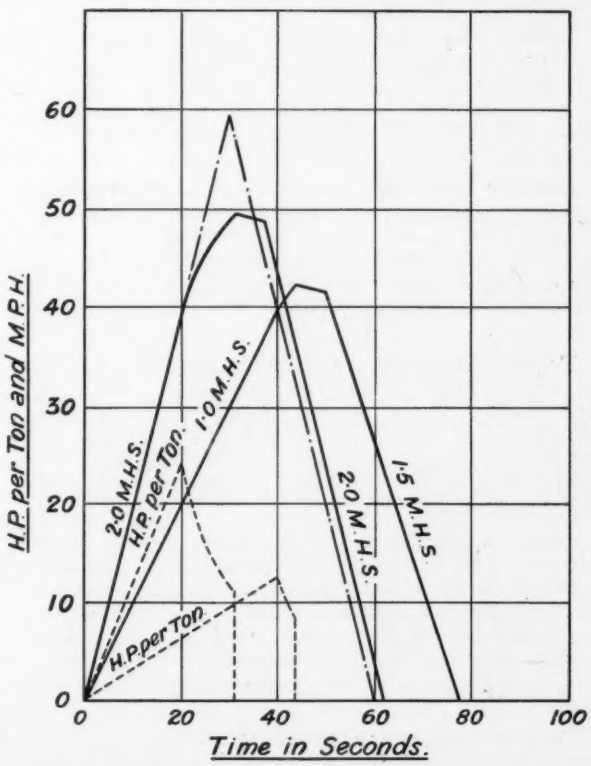


Fig. 3—Effect of different acceleration and deceleration rates on schedule

90 watt-hours per ton-mile, and as the useful work done in moving the train against the resistance to traction is only about 20 watt-hours per ton-mile, a reliable system of regeneration capable of returning a high proportion of the braking energy would appear to offer considerable advantage. It is probably not worth while to attempt to actually stop the train by regeneration, but it would be sufficient to reduce the speed to 10 m.p.h. (as at that speed the stored energy is only $\frac{1}{16}$ of that at 40 m.p.h.) and complete the stop using the brakes. Nevertheless, experiments are being conducted by the London Passenger Transport Board with the metadyne system of control which gives regenerative braking to a standstill, and the theoretical advantages are such that this may yet prove to be the system of the future.

1,500-volt d.c. Met-Vick suburban electric train at Barcelona, Northern Railway of Spain

NOTES AND NEWS

Japanese Short-Line Conversion.—The Japanese Government Railways is to spend £350,000 on the electrification at 1,500 volts d.c. of the Funabaski-Chiba section of the Chobu railway.

Australian Suburban Extension.—The 1,500-volt d.c. Melbourne suburban electrified network of the Victorian Government Railways is to be extended from Ferntree Gully to Belgrave, at a cost of £100,000. The scheme also involves the conversion of this line from narrow to broad gauge.

Moscow Underground.—Although numerous trial and special trips have been made during the last six months, it was not until May 15 that a regular public service was inaugurated over the Moscow underground railway. The official opening of the first section was performed by M. Stalin.

British Electrification.—Replying to a question in Parliament, Captain Hudson, Parliamentary Secretary to the Minister of Transport, said that the route mileage of electrified railway in Great Britain at the ends of the years 1900, 1910, 1920, 1930, and 1934, were, respectively, about 25, 203, 370, 615, and 702.

Another New York Subway.—At a cost of approximately $10,000,000, the city authorities of New York are to build a new underground railway between Eighth Street and 59th Street, which will run under Sixth Avenue. On the completion of this line, about three years hence, the existing elevated railway over Sixth Avenue will be dismantled.

Traffic Increases in Copenhagen.—The average increase in traffic on the suburban lines of the Danish State Railways round Copenhagen has been about 200 per cent. since electrification, but since the fares on the sections within the city of Copenhagen have been lowered to the rate of those on the trams, the increase on those lines has been about 600 per cent.

Austrian Programme.—It has been decided to proceed with the electrification of the 196-mile main line of the Austrian Federal Railways from Vienna (West) to Salzburg, and to have the conversion completed by 1940, at a total cost of 180,000,000 schillings. An Austrian internal loan of 150,000,000 schillings is to be floated shortly, and some of this will be devoted to the initial work of conversion.

Turkish Conversion Proposals.—Plans have been drawn up by the Turkish Government for the electrification of certain lines in the Taurus mountains and in the north part of Asia Minor. The first line to be converted will be that from Filios to Eregli. It is stated that already an order worth £T.11,000,000 has been placed with the Krupp-controlled Oriental Consortium for the supply of railway electrification material.

Light-Weight Trains for New York.—Two high-speed, light-weight, multiple-unit trains—one of aluminum alloy and the other of stainless steel—were built for the New York Rapid Transit Corporation during 1934, and are now being operated in local service on the subway and elevated lines. The aluminium train was built by the Pullman Car and Manufacturing Corporation, and the stainless steel set (see *Electric Railway Traction Supplement* for December 14, 1934) by the E. G. Budd Manufacturing Company.

German Main-Line Electrification.—On May 10, Dr. Dorpmüller, General Manager of the Reichsbahn, opened to electric traction the 86-mile line between Augsburg and Nuremberg, the latest extension of the Bavaria-Württemberg 15,000-volt single-phase electrified system. The cost of conversion amounted to 34,350,000 RM. of which 13,000,000 RM. were expended on locomotives and rolling stock. The construction of a 65-mile 100 kV transmission line was necessary in order to supply power to the railway.

Paris Metropolitan.—On April 28 the new No. 11 line of the Paris Metropolitan was opened to public service. It extends from Châtelet to Porte des Lilas, and in the 4½ miles are 12 stations. The work was begun in 1930, but unusual engineering difficulties prolonged the time of construction. The tunnel runs below the Place de la Republique (where already four Metro tunnels and their connecting passages were in existence) at a depth of 60 ft., and under the hill known as the Butte de Belleville there is a gradient of 1 in 25. All the stations except one are provided with escalators.

Buenos Aires Underground.—The fourth underground railway (work on which is stated to have been commenced) is a combination of two concessions obtained some time ago. It will run from the Place de Mayo along the Diagonal Roque S. Pena, and the Santa Fe and Cabildo Avenues to Belgrano. It is being built by the Spanish company responsible for the third line, described in the *Electric Railway Traction Supplement* for April 5. After the opening of the first section of the latter in November, 1934, the Buenos Aires City Council ordered a temporary closing because of unsatisfactory operation, but a public service is now running.

XUM